A HISTORY OF THE MACHINE-WROUGHT HOSIERY AND LACE MANUFACTURES.

A HISTORY

OF THE

MACHINE-WROUGHT HOSIERY

AND

LACE MANUFACTURES.

BY

WILLIAM FELKIN, F.L.S., F.S.S.

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INTRODUCTION.

Some of the most interesting and useful works to be found in modern literature have been written on subjects which, while tending to gratify a universal and desirable curiosity as to the natural and scientific world around, have shewn how, by the activity and ingenuity of individuals, nature and science have been made contributive to highly important results, and have furnished a wholesome stimulus to endeavours thus to benefit mankind. With such a view the present work has been undertaken. It possesses this specialty: that, with the exception of two principal names, Lee and Strutt, every one of the many English inventors described, was a *working handicraftsman*. And while the two first local historians were professional men, the three last (including the present author) were also originally in that class; a fact not without significance. We will go on to describe our literary predecessors.

Robert Thoroton, M.D., published, in 1677, his *History of Nottinghamshire*, in a large folio volume, closely printed in small type. This writer was born in 1622, and was a descendant of an old family settled at Thoroton in that county. Having taken his degree at one of the Universities, he practised through life at Car-Colston, Nottinghamshire, where he was buried in 1678. He was a great royalist. His father-in-law, Serjeant Bown, had collected at much expense materials for this history, which the Doctor verified and completed, forming a work of extraordinary topographical and genealogical research and authority. It contains

a very important paragraph upon the origin of the stocking-frame, which is cited, and its tenor and value discussed in our memoir of Rev. William Lee.

The next local historian was Charles Deering, M.D., who was probably a German by birth. His education and learning indicated a respectable parentage. He was master of many languages and was otherwise highly accomplished. Having graduated at Leyden, he became secretary to the British embassy at St. Petersburg. The circumstances which brought him to Nottingham are not known. He practised there for some years with success. He married; but his wife dying after a short union, her loss injured his temper, and his manners became morose, causing the alienation of most of his friends. His practice gradually declining, he fell into deep melancholy and distress, and thus died in 1749. Not leaving sufficient effects, the corporation of the town contributed to the expenses of his burial, as a *posthumous* mark of respect for his undoubted talents. It was thus reserved for an alien to write the first historical account of Nottingham, his adopted abode. He was assisted in the antiquarian part of the work by John Plumtre, Esq., who also superintended its publication in 1751, after the author's decease. Deering appears to have employed the enforced leisure of his later years, in making researches necessary for the compilation of his work. His notices of the ancient trades of the town are valuable; some of them referring to the hosiery manufacture will be found in the following pages.

Mr. John Throsby, the son of a mayor of Leicester, of which town and county he wrote historic accounts, republished Thoroton's work with extracts from Deering and continuations of his own. His only reference to the stocking trade is in a paragraph concerning the petition of the frame-work knitters to Cromwell for a charter.

No further attempt of importance to write upon the staple trades of the three midland counties was made, until Mr. John Blackner composed his *History of Nottingham*, which was published in a quarto volume in 1816. Henson describes him "as skilled in the manufacture of both hosiery and lace; but from a lengthened indisposition he was rendered unequal to the task" (of compiling the history) "and the expectation of approaching dissolution, which soon took place, compelled him to expedite its termination." Blackner has given a large space to the origin of the stocking-frame, and its course of improvement, until the invention of warp and bobbin net machinery. With these he does not grapple—"because, from the number of different constructions, every minor improvement cannot be mentioned. The principal parts of the machines have been traced to their origin, and to those persons whose names have been mentioned, I conceive the great merit of invention to be due." In doing this, his political and personal prejudices sometimes led him astray; causing Henson to speak of him "as a singular man, well known for his credulity and for his veracity." This volume has not afforded us much assistance.

Mr. Gravener Henson began a *History of the Frame-Work-Knitting and Lace Trades;* and, in a moderate sized octavo volume published in 1831, brought his account down to the year 1780, but there ceased from the want of public support. This arose from his diffusive manner, and some peculiar opinions set forth with needless prominence. It contains much information on the rise of the manufacture of tissued fabrics, and the early course of those on which he specially treats. He had a practical knowledge of most kinds of looms, and describes them correctly, though in a technical manner. Being familiar with local inventions, he had materials to work upon, and it is to be regretted

he did not finish his history. His printer, seeing that instead of one volume, several on his plan would be necessary, advised him to condense. He had not the nerve to do this, and gave up the work. Henson wrote with surprising facility and grammatical correctness. His petitions to parliament, memorials to ministers, and letters to public men were striking, but injudicious: often containing libellous invectives. Once, being directed to draw up a memorial to the Treasury on the difficult subject of the 'Export of Machinery,' he brought the next day twelve foolscap pages closely written, without interlineation or blot; which, after being compressed and expurgated much to his chagrin, was a cogent and effective document.

In 1828, G. Henson published a list of one hundred inventions and alterations in the stocking and lace machines. Though not absolutely correct, it is convenient for reference, especially as to the contending claimants for improvements. He left behind him 'Notes of inventions and improvements of lace machines down to the year 1850.' These having been placed in our hands temporarily, have rendered valuable aid.

He wrote many articles upon local trade, the claims of workmen, combination laws, and kindred topics, giving parliamentary evidence on some of them. These papers shewed much vigour, but were deficient in exactitude. His roving spirit led to the knowledge of the proceedings of smugglers all round the coasts of England, Scotland, and the west coast and northern frontier of France. The names of these he offered, in 1835, to the English Customs. In the hosiery trade he had a list, in 1838, of one hundred and twenty-seven men who dealt in materials obtained by fraud, and another of all those who paid wages by truck. Being an adviser of workmen in trouble, and in combinations and strikes, he was more than once imprisoned during a

suspension of the Habeas Corpus Act; and often talked with pride of his examinations by secretaries of state, and familiarity with Government officials. In person he was thick set, with short neck, keen small eyes, and a head very broad at the base, rising up angularly to an unusual height.

Mr. Henson was a native of Nottingham. He had little early education, but afterwards read much. He possessed an extraordinary memory, and delighted in the histories of manufactures and commerce. He knew most of the laws of his own country and France regulating these matters. His first employment was in the stocking-frame, then in point net, and afterwards in bobbin net, and he knew many of those who had improved those classes of machines. A recent writer places him amongst the 'worthies of Nottingham.' Others differed from this; for which his dogmatism and warm temperament may account. We do not doubt his desire and efforts were to forward the interests of the trades he had so much at heart. He died at the age of 67, in 1852, at Nottingham, in humble circumstances.

The writer of this volume entered the stocking-making business in 1808, and the lace trade in 1819. In each he has been called upon to take an active part; and, since 1828, a public position in many of the transactions of both, until 1864. The knowledge of persons and events thus necessarily acquired, he has been often urged to embody in such a work as the present. Having been freed from other pressing duties, he has devoted the whole of the seventy-second year of his life to this effort. It has been a laborious one, from the necessity of giving an account of many inventions, patents for which, in numbers and prolixity of specification probably unexampled in any other manufacture, have had to be investigated. The short notices of these in the Patent list, issued from the Office

in London since this work was written, fills a volume of 1070 pages. The present author has accounts of 388 English patents in hosiery, and 331 in lace—719 altogether, many of them of immense length. The study of these mechanical descriptions is not favourable to elegance of composition, which may account for some defects in this volume. Such an intricate mass of details must also, after employing the utmost care, produce errors in narration. But in regard to the most important point of all, the author is conscious of having pursued one course—that of cautious inquiry into facts and bringing to them an unprejudiced mind, in order to form and express a sound judgment in regard to them; so that if not always unquestionably right, he is never intentionally wrong. The plan of the work is open to some objections, but no arrangement seemed free from them. A separate view is given, as far as possible, of what each inventor accomplished; that being the easiest for the memory to retain, by approaching nearest to classification of machines. To have given a regular chronological account of invention would have been impossible. The history of the trades has been confined to prominent events in consecutive epochs.

The author desires the acceptance of his best thanks for the assistance rendered by friends interested in the completeness of the volume, both at home, in France, Saxony, and the United States. Their contributions are invaluable.

W. F.

Nottingham,
March 15th, 1867.

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CHAPTER I.

THE OLD HAND WEAVING-LOOM.

Authentic and instructive History is a carefully selected and well ordered narration of events; a consecutive statement of facts and opinions, whether religious, political, social, or scientific, which have transpired in past ages, bearing upon the condition and welfare of mankind.

Whatever department of historical enquiry is pursued, the mind intuitively seeks to investigate and ascertain its source; the fountain from whence to follow the course of that stream of events, which it is desired to trace out.

The origin of empires and states is for the most part hidden in the uncertain mists of antiquity, and is usually mythological, rather than ascertained and real. Very learned men differ greatly as to the point of time when, in regard to any one of the great national divisions of the human race, fabulous legends cease, and truly reliable records begin.

An inquiry into the origin and progress of the useful arts, that "large field of knowledge open to the advantage of men," is prompted by the like desire to begin at the beginning; and is found to be surrounded with equal obscurity and difficulty. So much has this been felt that an often controverted question has arisen, as to whether or not the knowledge of the arts practised in antidiluvian ages was the result of innate genius,

called into exercise by the immediate daily necessities of man's life; or whether derived by him from the direct instruction of his Maker.

Archbishop Whately asserts, "that wholly untaught savages could never invent anything, or even subsist at all. The existence of various instruments amongst partially civilized people, indicates the communication of instruction at some period from a being superior to man himself." It is argued that man could neither make, nor civilize himself; and that it is most consistent with reason, and with what may be gathered from Scripture on this subject, that man was advanced by his Creator, soon after He had formed him, to a state above that of a mere savage, if he were not so endowed originally.

The practice of steeping stalks of plants and pounding the inner fibrous bark of trees, to obtain materials for clothing; securing hair and wool from skins to spin into yarn; making lines and hooks as well as nets for fishing and hunting; basket wattling and weaving from flags and rushes, with other arts; are spread so almost universally, and so nearly of one type, as to refer them to one source only. It is urged also, that if the primitive arts were self-discovered and self-taught, it is altogether unreasonable to suppose they would have remained, in the main, without improvement for three thousand years or more. Moreover, with the gifts of intelligence, mental power, and moral perception, expressing themselves in speech and action, the Maker of man would otherwise endow him suitably to the necessities of his being. He must eat, to live; he would be, indeed was, directed what to eat, and what to avoid. He received a command to dress and keep a garden. The meaning of the words and method of obeying them, would be shewn him. The qualities of animals and vegetables must have been in some measure opened up to him, or he could not have given the one distinguishing names, or successfully cultivated the other; and without primary instruction, Adam could not have known how to subordinate anything to his use.

But to what extent soever knowledge of material objects, with their powers and uses, was imparted to

man, it would be only so far as to stimulate him to improve them, and lead to the acquisition of more. God does for man, ordinarily, only that which he cannot do for himself. So, on the very first occasion for the exercise of ingenuity, our first parents "sewed (joined) fig-leaves together." This effort was imperfect, but in the right direction; and, so God made (Kitto says, 'taught them to make') "coats of skins, and clothed them." Cain built a city, which was not the act of a semi-savage; for, however rude its construction, skill was required to contrive, and knowledge to execute such a work. Of his descendant Lamech's sons, one was the first nomade, "a dweller in tents," possibly only covered with skins; but a pastoral cattle breeding life is one of observation, skill, and foresight. Another was the first instructor of artificers in copper and iron work. This implied the finding and smelting the metals, a thing hardly to be discovered; together with the possession of tools, and ability to use them. The third son was the first to handle the harp and pipe in music—requiring an attuned ear, and skill in workmanship. If a family thus advanced in art, lived two hundred and fifty or three hundred years after the expulsion of Adam from Eden, it is not unlikely that other primitive arts, not named in scripture, but necessary to man's comfort, were practised within the next fourteen hundred years previous to the flood. For though mankind degenerated into a state of terrible depravity, that was by no means inconsistent with a considerable amount of civilisation and general knowledge. To draw out the locks of hair and wool, and to spin them by distaff and spindle, has been a practice for certainly four thousand years; and to weave them into cloth by that oldest textile instrument, the weaver's loom, is an art equally traceable up to nearly the time of Noah. So that both may very probably have been employed in producing clothing for the antidiluvian world. He might see fit to suggest the loom, who directed the construction of that wonderful prototype of naval architecture, the ark; and some centuries later, gave to Bezaleel the special wisdom, necessary for the curious and splendid work of the Tabernacle.

But if not thus suggested—and it was due to the genius of man—the life long experience and observation of almost a thousand years might suffice for the discovery of the loom; and what was thus known, must, through Noah and his sons, have survived the flood. The eldest of these sons saw the rise of three mighty empires, Babylonia, Assyria and Egypt; in each of these, some of the arts, at least, were known, and carried to a high degree of excellence and importance, at the time their names first occur in history. The architecture of those earliest ages survives to attest this fact, by works mighty enough to puzzle modern science as to how they were performed, and to fill the minds of beholders with astonishment at the marvellous results. And long before the time of Abraham, the art of weaving—more useful, though less noticed historically—had so spread, that Babylon was famed for its textile manufactures; and so continued till its downfall. For it had a great customer in Tyre, as mentioned in those remarkable chapters 26th and 27th of Ezekiel, describing the commerce of the latter city, and stating that Babylon traded there; exporting to Tyre "its blue cloths, embroidered work, and chests of rich apparel." The like is there said of Syria and Mesopotamia also. Egypt was the early home of the linen cloth manufacture (probably, with India, that of cotton also) as is proved by sepulchral paintings, of the gathering and preparing flax and weaving it into cloth. The inhabitants of Egypt produced, and clothed their princes and nobles and priests, with fine twined linen, exporting it also to Tyre and Greece. Pharaoh clothed Joseph in vestures of fine twined linen suitable for a prince. The cerements of their embalmed dead were of cloth generally of coarse texture. The Israelites became very perfect in the art of weaving, while serving the Egyptians; and in the wilderness under the instruction of Bezaleel. "For all the women who were wise hearted spun, and Bezaleel worked the work of a weaver and in embroidery."

The sacred books of Hindostan shew that weaving of cotton goods was practised there, from nearly the time of the flood; this is further evidenced by the castes connected with it. From the same epoch, the most ancient Chinese historical works date the use of the loom;

almost identical in its shape and functions with that now employed by them; upon it, they wove silk, as well as cotton and wool. All the preparatory arts of growing silk, cotton, and wool, spinning and reeling, winding and warping, are fully described; as also the subsequent ones of dyeing, fulling, embroidering, and fashioning into clothes.

The city of Damascus, perhaps the oldest existing city in the world, was almost from its foundation known, and some centuries afterwards became famous, for its textile manufactures. This it has continued to be until the present time. How long it was before silk was employed as a material, and the loom was adapted at Damascus to weave patterns of various design, and in the gorgeous colours so dear to Eastern taste, is not on record. If the weaving-loom were originally invented, to devise the shuttle and its bobbin, to extend some hundreds of threads as a warp along the ground, dividing them into two alternating sets; hanging the gearing aloft on the branch of a tree, the weaver seated on the ground, with his feet in a hole moving the treddles—as was often the primitive manner of Eastern weaving—would require great compass of thought. How much more, to introduce the Arabesque ornaments, and even to inweave in graceful wreaths of Arabic characters, the multitude of extracts from the Koran, which appear in the sacred silken Banner of Mahomet and of War, which is of immense size, the production of a Damascene loom, and the original of which was woven centuries ago. In all ages the most costly and precious stuffs from the loom have been reserved for royal and sacerdotal purposes. The cloths manufactured in Asia Minor, and dipped in Tyrian purple dye, were always worn by rulers from Cyrus and Alexander, to the Ptolemies and Cæsars, as the sign of imperial authority. It is probable, that impelled by the love of pure and bright hues, the Asiatics understood and practised the arts of the fuller and dyer better in the first fifteen hundred years after Noah, than at any time since, until within the last century.

The town of Gaza was known from ancient days as an important cloth weaving place. It was not far

from Tyre, and on the high road from Syria and the East into Egypt, so the productions of its looms were celebrated far and wide. At a time when silk materials for clothing were valued in Syria weight for weight in gold, the manufacturers of Gaza adopted the plan of taking in pieces the heavy silk fabrics obtained from the East, and dividing the thick threads of which they were composed by untwisting them with great care, they re-wove these finer strands into a semi-transparent tissue, which was, from its lessened cost, much used in Greece, and eventually in Italy. This was about the time when a Roman Emperor refused his wife a sumptuous silk dress because of its cost. Pliny and Seneca held up to ridicule the use by their country women of "gowns of glass" made from these slight materials, "clothed in which they could not justly say they were not naked." The fabric in question was called after the place of its origin, and is known in French as La Gaze, in English, Gauze.

It would seem from this account, that the supply of silk was as yet solely obtained from the farther East, Hindostan, and China.

The practice of weaving being the universal employment of women from the remotest ages, was so familiar and generally understood, as to furnish writers, sacred and profane, with many touching illustrations and similes. Children are familiar with Bible examples: "I have cut off like a weaver my life." "My days are swifter than a weaver's shuttle." "They weave a spider's web." Similar allusions occur in classic literature.

These manufactures of cloth by the use of the loom, were thus practised and spread abroad in ancient times throughout all Asia. It is worthy of notice that the first countries where we read of them, Babylonia and Egypt, were those where sciences, especially that of Astronomy, had their first development. There seems at first to be a wide distance between the contemplative sciences and useful arts, but it is more in appearance than reality. There is in truth a close underlying connection between them. The arts are ever assisted and ennobled by science: which itself loses its speculative tendencies when in combination with art. They,

by their united operations, stimulate invention and shorten or lighten labour; and by the use of agents and materials in new forms and quantities, they procure those novel results which enrich mankind, by adding to the common stock of comforts and conveniences of life.

Let this early art of weaving cloth therefore have attributed to it the merit and importance which are its due. "The first want of man after food is clothing: this art supplies it; its utility, therefore, is inferior only to that of agriculture."

From Egypt, Palestine, and Asia Minor, the weaving art passed long before the age of Homer into Greece, and thence, over all the shores of the Mediterranean. It penetrated Italy and Spain. Probably by way of Constantinople it spread over Illyria, Dalmatia, and the German tribes, and descending the Rhine, reached the Low Countries and France. By the Flemings, weaving was brought over and firmly settled in England; and thus reached Scotland and Ireland.

This course occupied in the whole about two thousand years, and is one of deep interest to the student of history. It was marked throughout, like the general operations of manufactures and commerce, by the contending forces of religious persecution or toleration; political despotism or freedom; hospitality to aliens, or a narrow and exclusive policy towards strangers. But its utility was a vital irrepressible power, and overcame every obstacle. At length, the rude and hitherto almost unchanged old loom has been made the subject of surprising improvement, and has been for plain goods more than doubled, and for fancy articles more than quadrupled, in its power and speed of production. In a word, it has within the last century become the *Power loom* in England, and *Jacquard loom* in France.

Soon after the introduction from the Low Countries, and settlement of the weaving art by the Flemings at Norwich, Sudbury, &c., the great importance attached to the business was shewn by the legislative enactments of the Normans and Plantagenets, intended to regulate and (as was the opinion of the time) to foster the rising woollen manufactures. These were then the objects of special attention, because of the capacity

of England to grow the wool that might be required to supply them with materials. The speaker of the House of Lords was seated on a woolsack, to remind him and the Peers of the value of the woollen trade. The tax on imported wool was remitted under Edward I. An act of the third Edward made its export a felony. None but English-made woollen cloths might be worn. They were prohibited import, under pain of forfeiture of the goods, and imprisonment of the importer. Foreign weavers were invited to come over here; which they did, in such large numbers, as to thoroughly establish the business, in which, by their skill, industry, and capital, they became the principal employers and merchants. Within the next two hundred years, England had attained the position of a large cloth exporting nation. In 1463—75, articles were prohibited import; and in 1483, 1 Richard III., many more were added to the list. As to a large part of this list, the prohibition was not repealed until 1819.

In the Woollen Cloth Act, 5 Edward VI., twenty-three districts in England give names to woollen cloths, and five to cotton. Six special classes of cloth had been defined by 37 Edward III., chapters viii. to xiv.; and ordered to be alone used. Clothiers were commanded to make no other. These regulations were re-enacted three times, up to the reign of Henry VIII.; and again, by other subsequent acts: but after existing 240 years, they were abolished by James I., in the first year of his reign.

Cotton wool was used in England for twisting into candle wicks before 1298, and was largely imported from the Levant by 1430. In 1640 it had become extensively spun, and made into cloth in Manchester, from whence the three noble minded brothers Chethams supplied the London market with fustians, &c.

The rate of remuneration for labour was also made the subject of legislation throughout this period. A plague in 1346, and consequent mortality, had so lessened the population as to have doubled, and in some trades, trebled wages. In 1350, it was enacted that the former ordinary scale should be paid and received; an oath being taken by both masters and

men to pay and receive no more; *i.e.*, for day labourers, 2*d.* a day (6*d.* of our present money), and 3*d.* (9*d.*) in harvest; carpenters and other artificers to receive the same. In 1495, it is said that a day labourer could earn in a week the price of a sheep. By the statute of labour passed in 1563, the rate of wages was ordered to be fixed by the Justices. During the Wars of the Roses, the favour shewn to foreign artizans, by exemptions from imposts, and in other ways, having caused them to outnumber the native work people in many places, especially in London, where there were 1500 in excess, and the English had generally become their servants in trade—Cardinal Wolsey, while presiding in the Court of the Star Chamber, got this state of things arbitrarily reversed, by a peremptory enactment, that foreign weavers and artificers should invariably serve under English employers. Such was the state, political and social, of the times, that this extraordinary measure seems to have been carried into effect, without material opposition or any commotion whatever. This act of that great statesman has been highly praised, even in the present century, by more than one writer, as a politic and patriotic one. But it cannot be wise policy to repress genius, or teach contentment with low national attainments. Neither does true patriotism require the return of ingratitude for favours received at the hands of foreigners by withholding their just and well earned reward. This legislation probably did much to retard and injure the progress of this and other branches of our national manufactures.

These preliminary observations in regard to the weaving-loom have been offered because of its antiquity and world wide use; the simplicity of its construction; its standing absolutely alone, until three centuries ago, in textile mechanical invention; the vast importance attached to its introduction and use in this country by Kings and Parliaments; and the relation its most essential parts bear to the machinery eventually devised and employed in the fabrication of lace,—this being one of the subjects treated of in this work.

CHAPTER II.

HAND-KNITTING.

A QUESTION of much interest presents itself on entering upon the events that transpired in the sixteenth century, and which is directly connected with the manufacture of hosiery by machinery. It is inquired, at what time, where, and by whom, was the art of elastic loop hand-knitting first practised? No positive answer can be given on any of these points.

It has been seen that no rival machine was devised for performing textile operations. But the mind would be ever engaged in selecting natural productions to serve as materials; and in searching out useful processes and inventions, in which they might be employed by well directed skill and labour. The brain and fingers of men are scarcely ever at rest. They will twist and intertwine; double and redouble cordage; loop, plait, knot, and knit, in ways almost infinitely various. In like manner, under man's plastic management, silk and flax and wool acquire superior fineness, strength, and brightness; and have thus become better prepared for textile use. Sinewy arms and dexterous hands are in fact the natural machinery by which he operates often very beautifully and effectively, without any adventitious mechanical aid whatever. Thus observing the peculiar qualities of the various objects around, his mind suggests uses for them; and seeing what is to be done, at length finds out the way to do it. By this tentative course, river flags were formed into baskets; reeds, and the inner bark of trees were changed into paper; the outer rind into ropes; bullrushes were interlaced and made into an ark, which, plastered with bitumen, might safely glide down the stream; and wattled twigs of the willow, shaped boat fashion, perhaps after the great ship of the

Deluge, and being covered with skins, were found sufficient to bear adventurous mariners over stormy seas.

From the time of the Pharaohs and of Job, fishing nets were used. These were made by using one line only, usually a cord of hemp or other strong twisted fibres, wound on a bobbin placed in a shuttle held in the hand, by which meshes were formed, whose corners were so firmly knotted as not easily to be broken; and if broken, the cord would not run out any further. These nets were of course non-elastic.

In elastic looped hand-knitting, one continuous thread only is employed in the construction of the web; there is therefore neither warp nor weft. Two or more skewers of wood or iron, called needles, are used. One of these is held in each hand. A first series of loops having been formed on the left hand, the right hand needle is inserted into the first loop on the other pin; the thread is passed round it, and it is drawn through, when the stitch thus worked into is slipped off upon the web already wrought. Thus the loops are formed side by side successively upon the needles; not one looped on its immediate predecessor, as boys form loops down the length of a string; but each passing through a loop, formed in a previous row next below it. The web may be either produced round, as in a stocking, and widened or narrowed at pleasure; or in a straight line of any desired width, with a perfect selvage on each side. Simple patterns are easily made, by looping in different ways; and variegated designs, by the introduction of additional colours. This tissue is perfectly elastic, which is the quality that most adapts it for usefulness. It can be extended without permanent enlargement or distortion in its shape; and consequently adjusts itself with ease to the size of any part of the body for which it has been made, and on which it is worn; and when drawn off, returns to its former state. It has, however, a corresponding disqualification; if the thread be broken or left loose, the whole tissue may be unroved, or may unrove itself by pressure, loop by loop, with great rapidity. Hence the importance of strong even yarn or thread, and sound fabrication.

The simplicity of the operation, and the ease with which it may be learnt and performed, make it probable, as some have asserted, that this kind of knitting as well as others, was known and practised, if not by the antediluvians, by their immediate descendants. It is true, that no plain record or description of such a process has come down to us. But it is contended, that some of the references to stuffs and their production in ancient times, cannot be made to harmonize with their being manufactured on the weaving-loom. The inference sought to be established is, that as tissues answering to those described as having been anciently wrought, could be produced by hand-knitting in a way far more consonant to the circumstances under which they were said to be wrought, it is fair to presume that this was the process employed.

The passages chiefly relied on are in the Iliad and Odyssey. In the third book of the Iliad, Iris visits Helen. Pope, in his translation of this descriptive passage, says—

> "Her, in her palace at her loom she found—
> The golden web her own sad story crown'd;
> The Trojan wars she weaved—herself the prize."

It is objected that it is not probable these princesses and their maids in Troy should be occupied in a kind of workshop, in which each laboured at a weaving-loom; and that, a figuring loom; also, in order to produce such a fabric as that described, one of such magnitude and intricacy of movements, with so great a variety of materials, as would require a multitude of sleys and treddles; the continued selection of threads for weft; and the action of two persons, one on each side of the machine, to throw the shuttle to and fro. Pope probably knew weaving only as being performed with warp and woof. The words of the original may be literally rendered, "She was weaving a large web; double surfaced and variegated; in which she interwove the many Trojan conflicts." Cowper translates thus: "She found her weaving a gorgeous web, inwrought with fiery conflicts." Mr. Wright, in his late translation, says—

> "Her she found
> Within her palace walls, weaving a robe
> Of double texture, large, of purple dye,
> Wherein she traced the many grievous toils, &c."

The Earl of Derby, in his still later work, gives this version—

> "She, in her chamber found
> Her whom she sought; a mighty web she wove,
> Of double woof, and brilliant hues: whereon
> Was interwoven many a toilsome strife
> Of Trojan warriors," &c.

Chapman, in his homely phrase, says—

> "She found Queen Helena at home
> At work about a weed, woven for herself.
> It shined like fire, was rich and full of size,
> The work of both sides being alike; in which
> She did comprize the many labors warlike Troy endured," &c.

No mention is therefore made by Homer of the loom in this description, and to adjust its various parts to a loom, the mighty web, the double texture, and historic action, wrought in brilliant hues, would be a task to be performed with difficulty even in modern times: more practicable however for women in ancient Troy with knitting needles than on the weaver's loom. In whatever way performed, it must have required, to fulfil the poet's picture, admirable skill and patience.

In Hector's parting with Andromache, Pope uses the word 'loom,' twice. "In Argive looms our battles to design" &c. Mr. Wright here uses it also: "Carried to Argos.....there in labor of the loom employed." And Lord Derby gives it in like manner—

> "Haply in Argos, at a mistress' beck,
> Condemned to ply the loom."

But it is submitted whether it may not be rendered, "There you shall weave the web, under the command of another."

In the conclusion of the same affecting scene, Pope uses the term 'loom', and so does Mr. Wright—

> "Now home; there ply thy proper arts—the loom
> And distaff; task thy maidens there."

Cowper says—

> "Hence then to our abode; there weave, and spin,
> And task thy maidens."

Another reference to this employment occurs, when news is brought to Andromache of Hector's death. She

is described in the same words that are used in reference to Helen, and thus given by Cowper—

> "She in her chamber at the palace top,
> A splendid texture wrought; on either side
> All dazzling bright, with flowers of various hues."

Mr. Wright's version is—

> "She in a chamber of her lofty palace
> Wove a large double purple robe, inlaid
> With rich embroidery."

The Earl of Derby thus renders it—

> "In her house withdrawn,
> A web she wove, all purple, double woof,
> With varied flowers, in rich embroidery."

Further extracts add to, rather than diminish, the difficulty of supposing these weavings to have been accomplished by Helen and Andromache in the loom. If to lessen it, narrow plain woven stuffs were to be used as the ground work for rich historic embroidery, in colours to be applied by the needle or hook, the difficulty is only partly removed; the stuffs had a double loop, a double face, "each side alike, strewed curiously with various flowers." How even this could be done it is very difficult to understand.

In the description Homer gives in the Odyssey of the labours of Penelope, weaving a web by day which she unweaves at night, further mystery occurs, which it is thought cannot be otherwise solved than by the supposition that her work was a knitted web. If loom woven with warp and weft, very far more time would be required to take it to pieces than to weave it. There would be no time for the Queen to rest, if indeed the warp could remain uncut and so again each morning be found ready for use. But if it were knitted work, the labour of the day though long pursued, could be unroved in a few minutes and without any difficulty.

Whatever judgment may be come to upon the question, between loom-weaving and hand-knitting in the case of Homer's princesses, there can be no doubt that the tabernacle veil and curtains, together with the tissue from which Aaron's breastplate, ephod, and vestments were made, were wrought of various materials and in different colours in the weaving-loom, and afterwards

elaborately embroidered by hook or needle. So also was the longed for prize of Sisera's mother, "a prey of divers colours, of needlework on both sides." The art of ornamentation by embroidery seems to have been carried to great perfection in the earliest times. It is for the happiness of man that woman ever seeks to add to the merely useful that which is graceful and effective in form, colour and design.

The coat worn by Jesus before his crucifixion is described as being without seam, woven (margin 'wrought') "from the top throughout." How this could be effected upon the common loom, cannot be even conjectured. But if hand-knitting were then known, it might have been 'wrought' so as to answer the description perfectly, in that manner. The garment must have been one of a superior, probably costly character, or it would not have been so highly thought of, or so minutely described. And if the peculiar characteristic of hand-knitted web, that of roving out and thus becoming worthless were there, and known to the soldiers, that would be a sufficient motive for their casting lots upon it, rather than dividing it. This coat might thus have been the result of the blessed mother's tender care for HIM who was ever uppermost in her thoughts; or of the pious regard of one of that band of holy women, who attended the steps of this wonderful Person, through his life, and ceased not their ministry till with reverend care they had prepared his body for the grave.

But if knitting by hand were practised in the east before the Christian era, it is surprising that no direct historic mention should have been made of it until about the reign of our Henry IV.

It is true that in ancient times the leg was a part of the body which was left uncovered, and this practice was continued till comparatively modern times. Afterwards they were partly or wholly bandaged, as in Scotland and Italy to the present day.

When hose were first worn, they were cut out by scissors from cloth of wool, linen, or silk, according to the rank of the wearer for the most part, and sewn up. This, especially in heavy materials, resulted in ugly and uncomfortable seams.

The practice of wearing woven woollen caps, by the peasantry of England and Scotland, dates far back towards the Norman conquest. These were replaced by knitted caps; but at what particular time, is not recorded. When Chatterton published the poems which he attributed to Rowley, the opponents of their genuineness pointed out a supposed anachronism, bearing on this question of the time when hand-knitting first became known in England, in a singular manner. Under date of 1461 the poet introduces these lines—

"She sayde,
As herr Whytte honds, Whytte hosen were knyttinge,
Whatte pleasure ytte ys to be married."

As, up to the time the Rowley controversy arose, it had been the general belief that in 1461 hand-knitting was unknown here, the triumph of the unbelievers in Chatterton was great when these words were noticed. But so far as this passage was concerned it was of brief duration. Further examination brought to light the fact, that by an act of Henry VII., chap. 17, A.D. 1488, the price of felted hats was stated to be 1*s.* 8*d.* (or 5*s.* of present money), and of knitted woollen caps 2*s.* 8*d.* (8*s.*). An article of common wear in England, such as these caps were, must have been for years knitted here before they would be placed in an act of Parliament. There were eight acts of Parliament relating to clothing passed in the seventy-five years between 1488 and 1563, in several of which knit woollen caps are spoken of. In that of 1548 about twenty-six trades are named. In that of 1563, called the statute of servants, it was enacted that every person not being possessed of twenty marks (£13. 6*s.* 8*d.*) rental, should wear on Sundays and holidays, when not on travel, a woollen knit cap, on pain of forfeiting 3*s.* 4*d.* (10*s.*) 'a-day.' This statute mentions thirty trades, which were not allowed to hire for less than a year. Amongst these are *hosiers*, clothiers, cloth-weavers, knee-cap-makers, &c. Twenty-four were allowed to take apprentices, though their parents had not lands or tenements; amongst these were turners, mill-wrights, linen and woollen weavers, fullers, &c.

Before 1530, the word 'knit' was well known in

England; and not unfrequently met with in the writings of that time. "I knitt bonnets or hosen." "She that sytteth knyttinge from morning to eve, can scarcely win her bread." In the household book of Sir Thomas L'Estrange of Hunstanton in Norfolk, under the date of 1533, is an entry: "peyd for 4 peyr of knytt hose VIII^{s}." these were for himself; and again in 1538, "peyd for 2 peyr I^{s}." these were for his children. An act of Parliament of Edward VI. was passed in 1552, which names the several articles of "knitte hose, knitte peticotes, knitte gloves, and knitte slieves."

It is probable that knitting stockings would, from the difficulty of forming the heels and feet of right shapes, follow knitting caps, only after some interval of time; and fine hand-knitting upon silk for hose, to be worn by kings and nobles, would follow much later, from the great additional skill necessary in such minute looping, and the excessive pressure on the eye attending the labour, whether in the production of white or black silk hose. Howell, in his *History of the World*, says, "that magnificent monarch Henry VIII. ordinarily wore cloth hose; except there came from Spain, by great chance, a pair of silk stockings." King Edward VI. was presented with a pair of silk stockings by Sir Thomas Gresham his merchant, and the present was much spoken of. Queen Elizabeth in the third year of her reign was presented by her silk woman, Mrs. Montague, with a pair of knitted black silk stockings, which this person's young serving women are said "to have quickly become so dextrous in knitting, that from thenceforth Elizabeth never wore cloth hose any more."

Although some have thought that the art of knitting woollen caps and hose came from Scotland to England, which is not improbable, the above reference of Howell to Spanish silk hose, combined with other circumstances, lead to the probability that *silk knitted* hose at least first came from Spain to us; and that the Spaniards learned the art through the Moors, from the Arabians, to whom the world has been indebted for so many other useful arts.

An account drawn from Stow has become popular,

and is to the following effect: "That in 1564, one William Riley, apprentice to master Thomas Burdett, having seen in the shop of an Italian merchant, a pair of knit *worsted* stockings from Mantua, borrowed them and made a pair exactly like them, and these are said to have been the first stockings of woollen yarn knit in England. They were worn by the Earl of Pembroke who had been one of the Council of Edward VI. The citations and dates above given shew that this statement is not correct. Knit woollen hose were made in this country long before. There is little likelihood that *woollen* knit hose should be imported from Mantua. But, wrought of *silk*, they would be suitable to Mantuan trade. Riley might have learnt to knit already. And if the youth saw, borrowed, and imitated knit *silk* hose, it was a feat worthy of the marked notice of Stow; and the stockings would be worthy of the powerful nobleman who is said to have worn them.

The practice of knitting hose, when once known, soon became general as a domestic employment; not of the lower classes only, but amongst the middle and higher classes also. In 1577 the peasants' wives, Harrison states, "used the bark of alder trees for dyeing the stockings they had knitted." The practice of dyeing the materials for knitted stockings, or of dyeing the work when done, has been continued by the peasantry in Scotland and France down to the present time.

In 1576 Gascoigne the poet says, the greatest ornaments of dress were, "knit silk stockings and Spanish leather shoes." When Queen Elizabeth visited Norwich in 1579, some children appeared before her, spinning worsted yarn, and some, knitting hose of that material. That the use of silk hose was soon by no means confined to royalty and courtiers, appears from the apostrophe of Prince Henry to Poins in Shakespeare's second part of Henry 4th.

"What a disgrace to me to remember thy name, or know thy face to-morrow; or to note how many pairs of silk hose thou hast; namely, these and those that were the peach coloured ones."

It has been suggested by Beckman that this art of hand-knitting may have resulted from that of wire

working as seen in the screens at Lubec Cathedral, wrought in 1572, and in St. John's at Wismar; where the ends of the wires cannot be found; these are said to be made by the Devil. There can be no doubt, that the introduction of this tissue, of so novel a kind, yet so useful and profitable, justified Elizabeth's anxiety for its prosperity, and her caution in regard to any interference with its progress.

Before dismissing it from further consideration, it is pleasant to quote the language of Beckman, who, in the fourth volume of his valuable *History of Inventions*, gives the following elegant description of hand-knitting: an occupation which, even down to the commencement of the present century, like hand-spinning on the wheel, was pursued throughout every rank of female society, from the palace to the cottage:

"It may be so easily acquired, even by children, as to be considered almost an amusement. It does not interrupt discourse, distract the attention, or check the powers of imagination. It forms a ready resource, when a vacuity occurs in conversation; or when a circumstance occurs, which ought to be heard or seen, but not treated with too much seriousness; the prudent knitter then hears and sees what she does not wish to seem to hear or to see. Knitting does no injury either to the body or to the mind. It occasions no prejudicial or injurious position; requires no straining of the eye sight; and can be performed with as much convenience when standing or walking, as when sitting. It may be interrupted without loss, and again resumed without trouble; and the whole apparatus for knitting, which is cheap, needs so little room and is so light, that it can be kept and gracefully carried about in a work-basket; the beauty of which displays the expertness, or at any rate the taste of the fair artist. Knitting belongs to the few useful occupations of old persons who have not lost the use of their hands. Servants, soldiers, shepherds, and the male children of the peasants who are unfit for hard labour should learn to knit, for it may be a pleasant and profitable employment for the leisure even of the male sex."

G. Henson, *History*, p. 36, gives an interesting view of the situation of the people in the reign of Elizabeth, in relation to manufacturing and other employments:

"The wages of every trade were fixed by laws; no person could work at any trade who had not been apprenticed to it. None but persons of respectability could be apprenticed to most trades; as it required their parents to have a certain weekly income. The handicrafts were mostly confined to corporate towns; and belonged to trade companies, who made their own bye-laws; which, upon being registered

by the Lord Chancellor, were acknowledged as legal; these trade companies chose the magistrates, who were amenable to the working class for their election. In the greater number of trades, hiring must be by the year; being under the age of thirty, and unmarried. Wardens were appointed by each trade to prevent fraudulent practices in the fabrication of manufactures. The merchants traded in companies, incorporated according to the lands to which they traded. Husbandmen in the villages were equally stationary, and their course marked out by law; their wages were fixed by the justices, their hours of working, and even their meals, were defined. They could not leave their villages or counties without a testimonial from the clergyman, or other respectable person. The feudal law, which required personal service instead of rent, was nearly abrogated; and a cottage with a comman right existed in almost every parish upon unenclosed lands."

A brief account of the kinds of machinery employed at the beginning of Elizabeth's reign will be useful, before proceeding to relate the notable invention of a machine soon after, which was intended to supersede (were that possible) the useful art of hand-knitting, and was destined to become the fruitful parent of the other almost innumerable textile inventions, which, with itself, are to form the subjects of this History. This list will serve to shew what scanty means were available at that time, for assisting to accomplish such an arduous and unprecedented design.

Water power and windmills had been employed for ages in grinding corn: also in later times in fulling, milling, and dressing cloth. The latter processes were as yet so imperfectly performed, however, that those cloths which were exported were sent in the unfinished state in which they issued from the looms. Carding and combing long wools by hand were well understood; but worsted was not allowed to be exported. Even the spinning wheel was, as yet, but little employed; the spole and distaff being commonly used. The looms for woollen and cotton weaving were very numerous and universally spread, but were constructed in almost their primitive simplicity, only varied in width and gearing to suit the materials and the articles to be produced; such as broad and narrow cloth, blankets, linsey woolseys, and linens or flannels. At Norwich, calendering machines were used. Mills for scribbling cloth had been devised, but their use was prohibited for fear of injuring the texture of the article, and

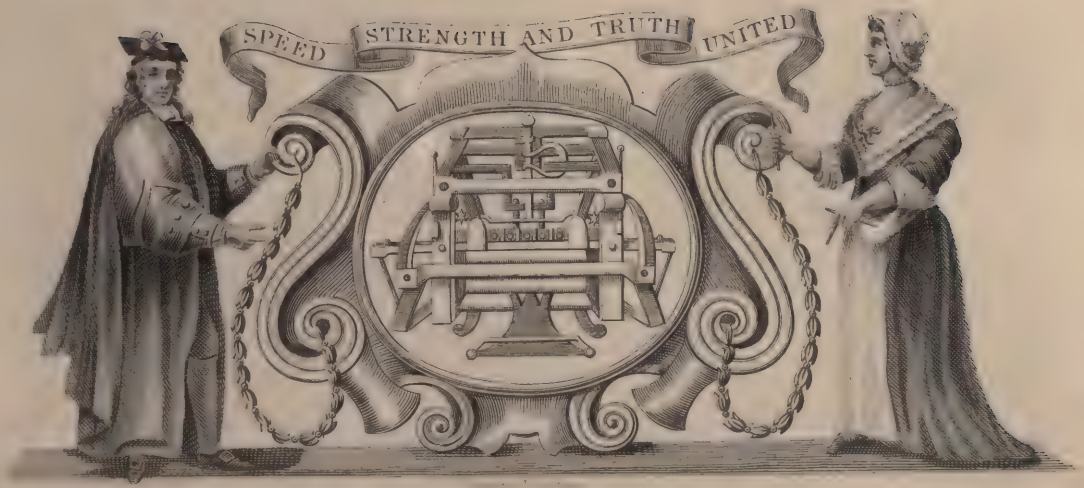
taysells (teazles) were re-employed for that purpose by order of Parliament. In like manner, cotton fustians might not have their nap raised by iron instruments, or machines, because of injuring their wear. Iron wire drawing was used for chain armour, as also wire of the precious metals for the use of gold and silver lace-makers, and for figured weaving purposes. This was early practised, to supply the demand for garments made from cloth of gold and silver. There were simple machines for platting stay-laces, and making silk or cotton fancy braids, to be wrought into needle-works. The turning-lathe was very much used. Casting of hollow cannon having been preceded by forged ordnance was long practised; till about 1730 it was followed by well constructed machinery for boring them. Metal pins were introduced from France in 1543. Within but a very short time after, machines had been constructed to be used in making pins. Hitherto, they had been filed to a point, and the head had been soldered on by hand. Great opposition was made to this novelty; but utility and cheapness prevailed in its favour. The common sewing needle was brought hither from India, after the discovery of the route by the Cape of Good Hope. Before that time sewing was performed in the method still used by shoemakers. A man discovered the method of punching the eye in steel needles; having kept his secret, he realized a large profit by it.

Although it may be truly said, that inventions in machinery and improvements in manufactures have been coincident with the decline of feudal governments, yet little progress had been made in this direction till the middle of the 16th century.

The very limited use of machines here indicated, shews that mechanical science was then but in its infancy in England; and it had advanced but little further in any other part of Europe. But the maritime power of the English had begun to be established and was soon followed by a mercantile marine, bringing in materials from distant parts to supply future manufactures; giving us the use of the natural products of the world, as if grown on our own hills and valleys; and while indefinitely increasing foreign commerce,

supplied means of comfort and enjoyment to the people formerly unknown. To bring about such a result it was necessary that a host of monopolies granted for the profit of nobles, money holders, and royal favourites, crippling commerce, and tying up the hands of manufacturers, should be swept away. So numerous and galling were they, that even the jealousy of Elizabeth in regard to trenching upon this part of her prerogative as of every other, was braved; and in the House of Commons, in a debate upon the abuse of monopolies, it was sarcastically asked "whether bread was not of the number?"

In the early part of the reign of James I. in proportion as the principles of constitutional government were brought into operation, many of these odious privileges were abolished. Freedom of thought was thereby stimulated in its exercise, and prompted the prolific brain of the inventor to new discoveries. By one or other of the important applications of practical mechanics to purposes of utility, which have since been made, processes have been rendered more easy and simple; new machinery has been created; and that already in use rendered less complex, and its results more abundant and satisfactory; till at length, articles of beauty and luxury in every department of manufactures, have been placed at a cost previously unthought of, in the hands of the consumer.


SPEED STRENGTH AND TRUTH UNITED

CHAPTER III.

INVENTION OF THE STOCKING-LOOM BY REV. WM. LEE.

If from reasons of state or social policy already hinted at, the construction of machines to replace or shorten human labour had, as yet, been little attempted; the time was now fast approaching when the arms, hands, and even fingers of men were to be imitated, not only in their ruder labours, but in some of their more intricate and difficult operations. The principle, that to shorten human labour by mechanical skill and power, is to increase riches and capital, and furnish more and better paid employment and consequently comforts to the artizan, has not even yet become sufficiently understood in England. In Elizabeth's time its benign light had only just begun to dawn upon a few of the more advanced minds in the nation. It was reserved for a mere incidental circumstance to furnish the first striking example, in modern ages, of its beneficent operation.

It will be anticipated that this example was the invention of a loom, capable of perfectly imitating the hand-knitter's movements, and producing the like results with manifold speed. At that time, to think of devising an instrument of the complex and nice adjustment required to effect this and to attempt it without any previous experience of his own or others, pointing to suitable methods and means, shewed a masculine will; and to carry it into effect, exhibited innate mechanical genius of the highest order on the part of the inventor.

The history of this important step in manufactures, as sketched by various writers, is not a little diversified, and in some points contradictory. It is not surprising that the origin of the older weaving and knitting processes should have been shrouded in mystery and doubt, when there is so much obscurity in the early

history of the stocking-frame as to cause these diverse statements, as to the place where the person by whom, and the reasons for which, this machine was invented. When they shall have been recited, it will probably be found, after all, not very difficult to arrive at a conclusion satisfactory to the mind of the impartial inquirer.

The discussion, though necessarily involving some repetition, is of sufficient interest and importance to justify a reliance on the reader's patience, for which, in this and some other instances, further apology is forborne.

Aubrey states that the inventor of the stocking-frame was a student of Oxford, and probably of Magdalen Hall. And Aaron Hill, in his Account of the Rise of the Beechwood Oil Invention, published in London, 1715, relates as follows, but gives neither name, date, or proof:

"The credit of the invention is due to an Oxford student, who was driven to it by dire necessity. The young man, falling in love with and marrying an Innkeeper's daughter, lost his fellowship by it, and soon fell into extreme poverty. They became miserable; not so much from their own sufferings, as from the dread of what would become of their unborn infant. Their only support was from knitting stockings, at which the woman was very expert. But sitting constantly together, and the scholar often fixing his eyes on the dexterous management of the needles by his wife, he thought it was possible to contrive a little loom to do the work with more expedition. This thought he communicated to his wife. He joined his head to her hands, and the endeavour succeeded to their wish. Thus the stocking-loom was mounted, by which he made himself and his family happy, and left this nation indebted to him for the export of silk stockings in great quantities, to the very countries from whence we before used to bring them, at a loss in the balance of our traffic. He became a man of considerable wealth."

In Evelyn's *Numismata*, p. 163, "Mr. Lee, or Leigh, a curate in some obscure part of Sussex," is mentioned as the inventor. Probably the name of the county is given by mistake for Nottinghamshire.

A writer in *Bibliotheca Topographia Brittanica*, No. 7, says, "the stocking-frame has been attributed to a Mr. Robinson, curate of Thurcaston, Leicestershire," but gives no further details.

The name of Robinson occurs nowhere else in connection with this invention. Aaron Hill's account

may be reasonably considered a version of those about to be given in reference to Lee, only mistaking the university.

These, together with a claim which has been made to the invention on behalf of France, which will be afterwards stated, seem to comprise all other names than that of Wm. Lee.

These statements of Aubrey, Aaron Hill, and others, tending to discredit the more generally received idea that Wm. Lea of Calverton, was the student at Cambridge, and of St. John's an M.A., have caused very rigid inquiries to be made in both universities, which have resulted in shewing that he was not of any Oxford College, and that he was not a Fellow, and never expelled from St. John's, or from any other College in Cambridge. It so occurred, however, that while these inquiries were prosecuting in many directions, as to the Collegiate course of Wm. Lee, attention was drawn to Hunter's *Hallamshire*, 1819, p. 141, in which is the following entry, taken from the books of the town trust of Sheffield: "1573. Item: gyven to William Lee, a poore scholler of Sheffield, towards the settynge him to the Universytie of Chambrydge, and buyinge him bookes and other furnyture (which money was afterwards returned) xiii*s.* iiii*d.*"

Upon this Mr. B. Woodcroft, F.R.S. of H. M. Patent Office, and who has bestowed very laudable pains upon this entire subject, remarks:

"The fact that Sheffield sent a William Lee to Cambridge, just before the invention of the stocking-frame, and at the very time probably when the other William Lee was there, is a singular coincidence in point of date, name, and University. Lee, from Sheffield, would be probably about 17 years of age when sent to College in 1573, and 34 in 1589, the year when the stocking-frame is said to have been invented; and 55 in 1610, when he (*i.e.* the inventor) is stated to have died." . . . . "The Sheffield Wm. Lee probably matriculated as a sizar of Clare hall, 26th May, 1570; B.A. 1573-4; M.A. 1577."—Cooper, Article on Wm. Lee, in *Athenæ Cantabrigiensis.*

Next to the statement, in a petition to Cromwell in 1656, afterwards to be more fully described, asking for a charter, the earliest strongest evidence, and as it would appear to the author, that which ought to be perfectly satisfactory authority for the statement which is

most generally accepted, as to the origin of the stocking-loom, is that which is given by Dr. Thoroton, at page 297 of his *History of Nottinghamshire*, folio edition, dated 1677, compiled by himself and his father-in-law, Serjeant Bown. It is as follows:

"At Calverton was born Wm. Lee, Master of Arts in Cambridge, and heir to a pretty freehold here; who seeing a woman knit, invented a loom to knit, in which he or his brother James performed and exercised before Queen Elizabeth, and leaving it to one Aston his apprentice, went beyond the seas, and was thereby esteemed the author of that ingenious machine, wherewith they now weave silk and other stockings &c. This..Aston added something to his master's invention, he was sometime a miller at Thoroton, nigh which place he was born."

The copy of Thoroton's folio, from which this extract has been taken, is in the Bromley House Library in Nottingham, and there is *written* on the margin of the page over against this paragraph, evidently several ages ago: "Ex relatione Johannis Story, Gent." The following further extracts from Thoroton will be interesting as to this family: At p. 296 the freeholders of Calverton in 1612 are enumerated, amongst whom is John Lee's. The name appears in Thoroton's account of several of the parishes around and near Calverton.

"3rd Edward 6th. All pastures and woods and the new Park in tenure of Godfrey Lee, remain to the most Rev. the Archbishop and church of Southwell."

In 1612, the owners of Southwell and East Thorp are said to be "Gervas Lee, Esq. &c." At p. 351,—

"Edward Lee, son of Gervas, is tenant of Overhall. In Norwel church, Notts. Arms are in the chancel," (1677) "granted (1564, 6th of Elizabeth) by Sir G. Dethick, alias Garter, to Elizabeth Lee, daughter of John Lee, of Stamford, Lincolnshire, wife to Sir John Lyon, Knt. an Alderman of London, and her posterity for ever."

And on a monument for Gervas Lee, Esq. in the same chancel, are similar armorial bearings. "All these bearings have Royal Quarterings." At p. 361, in 1612, Thomas Lee Gent is found amongst the list of owners at Sutton, in the hundred of Thurgarton. And that this family, at least in some of its branches, located in that immediate neighbourhood, were of some consideration as holding landed property, it may be further cited from Thoroton, p. 425:

"That Ed. Lee claimed amongst others against Roger Copley, Esq. the third part of the manor of Scafterworth, Notts. with its appurtenances; and the third part of twenty messuages, ten cottages, three hundred acres of land, forty of meadows, twenty of wood, three hundred acres of more, and 3*s.* 4*d.* rent—with appurtenances in Scafterworth, and five adjoining parishes in the division of Bassetlow." "Also the like claim against Richard Devenyshe, Esq., and against Sir Richard Carew, Knt." And further at p. 427, "that Henry VIII., in the 38th year of his reign, gave by letters patent to Sir Richard Lee and his heirs, the Grange and farm of Walkeringham, Notts. and all the lands meadows and pastures there, late belonging to the Monastery De Rupe alias Rock, in Yorkshire, then estimated at 114*s.*"

The places whose names occur in the above extracts are all not far distant from each other, lying in the same district. It will be observed that Thoroton gives Calverton the honor of being the birth-place of Lee. Most succeeding authors assign it to the adjoining parish of Woodborough, but state him to have officiated as a Clergyman at Calverton; one or two mention his being the Curate there. It is remarkable that this is not referred to by Thoroton, nor any other particulars of Lee's early life; and that though serjeant Bown and Dr. Thoroton resided all their lives in the immediate vicinity, the latter in active practice as a physician, and must have known Aston and Lee's brother at least by repute, probably personally, as having been during the latter part of their lives engaged in constructing and employing stocking-frames, they should have been content with the brief reference quoted above from their generally copious work. The volume was published only sixty-seven years after the death of William Lee. The facts were then accessible; so far as the brief notice goes, there seems no reason to doubt their accuracy; especially as the Doctor was manifestly impressed with the interest attaching to a person so well known and with the importance of the invention itself.

It is a vain regret, but it is impossible not to regret that nothing can now be ascertained as to Lee's youth or early education, or his distinguishing characteristics. These all seem, as has been well observed, to have been now long lost, even to local memories; partly, it may be, by the general dislike with which his invention was at first received by hand-knitters; and partly by his stay at Calverton, being so soon closed through his

removal to London, never to return; but principally through the business being for the first one hundred and fifty years, chiefly carried on in and near London, from which source, indeed, much of what is known to have taken place in the origin and early progress of stocking-making has come down to the present time. Nevertheless, there has been so much of interest taken by successive generations of the inhabitants of Woodborough and Calverton in this matter, as to have become embodied in traditions, which have several main particulars in common, and the substance of which will be found in relations about to be given.

The parochial registers of that period commence in this, as in many other instances, so late as to render imperfect assistance in this inquiry. The following letter, bearing on this subject from the Rev. Samuel Lealand Oldacres, Incumbent of Woodborough, dated 25th May 1859, is in answer to one addressed to him, by Mr. Cooper of Cambridge:

"In reply to your letter of May 20th, inquiring about Wm. Lee, the inventor of the stocking-frame, I have nothing useful to communicate. The parish register for Baptisms begins with 1547. John Lee had a daughter baptised in September 1577: Nicholas Lee had a son Christopher, in 1582; another son in 1583; Thos. Lee, in 1586; Isabell, in 1580; *William* 1592; He cannot be the Rev. W. L. who died in 1610; Mary, 1598; Nicholas, 1600. These last seven were all of N. Lee.

Marriages begin with 1573. Nicholas Lee was married October 1582; but his first child was baptised in April of the *same* year—

The register of funerals begins 1572; and at length we find something of Wm. Lee — Lee, the sonne of Wm., was buried March 1579. Perhaps this was a son of the inventor of the stocking-frame.

Wm. Lee, perhaps the father of the one your enquiry is about, was buried in 1587.

The family of Lee, or Lees, for it is spelled both ways, have continued in this parish to the present day. They are now farmers, butchers, joiners, cottagers, and owners of property, in the place. The brothers Thomas, William, and John, of one family, were lately Churchman, Methodist, and Baptist, respectively. They have a tradition that an Ancestor of their's was the inventor of the stocking-frame; and that he lived in a part of an old house now standing.

"The Parish of Woodborough contains a number of hosiery frames for stockings, gloves, shirts, &c. The stockingers are registered as Frame-Work-Knitters. Neither the ages nor business of any persons interred formerly were registered, nor the names of the ministers officiating were entered in the early registers."

The Author has had the opportunity afforded to him

of examining the parish registers of Calverton. For this he is indebted to the kindness of the Rev. S. Oliver, who has been for forty years the Vicar; and who, from the interest he takes in his predecessor in the ministry there, most willingly rendered his aid in the search. The registry begins 6th October, 1568, 21 years only before the date of Rev. W. Lee's invention; and could not therefore include a notice of his baptism. The following entries occur in it, viz., of—

"The baptism of four sons of William Lee, viz. Edward, in 1574; Robert, 1577; John, 1580; *James*, 1582. William Lee, the Elder; (sic) was buried 1595."

This implies that there was a Wm. Lee the younger, and who, if Thoroton be correct as to the Inventor being heir to the freehold estate, would be older than any of the four registered brothers, and probably born before the registry begins. For one—

"Robert Galfer married Elizabeth Lee in 1588, and also John Smythe married Dorothy Lee in 1590"

who might be two unregistered sisters older than the four brothers, and younger than the oldest, if that were Rev. W. Lee.

"Anne, the wife of Wm. Lee, was buried Jan. 1589-90. John Wrighte married Agnes Leighe, 1598. Wm., son of Ed^{d}. Lee, baptized 1606, and Henrie, son of John Lee in 1622. Marie, daughter of John Leigh, buried 1629. Ann, daughter of Henerie Lee, baptized in 1641. Ed^{d}. Lees married Jane Martin 1660. Margaret, wife of Ed^{d}. Lees, buried 1661. James, son of Wm. Lee baptized 1696, and Elizabeth, daughter of Wm. Lee in 1703. Henry and Barth^{w}. Lee buried in 1712. Sarah, daugher of Joseph Lee, baptized 1721, and ——— in 1723; Wm. Lee, buried 1729; and Elizth. Lee, widow, 1730; and John, son of James Lee 1734. There were baptized, Mary 1733, and Bartholomew 1739, children of John Lee; in 1733 John and Sarah, and in 1736 Wm., the children of James Lee. In 1761 John, son of Tho^{s}. (a farmer). In 1768 Catherine, and in 1773 another Catherine, daughters of Tho^{s}. Lee; in 1771 John, and in 1773 Hannah, children of Bartholomew Lee."

Finally, the following entry occurs in its regular order in the register, but reserved to this place, because of its importance:

"Buried, Joseph Lee, Stockiner, the last of the Family of Stocking-Frame Inventor Lee, in this Parish, 17 April, 1755."

The Incumbent who made this entry seems to have been a careful observer of the events of the times, and

susceptible of much Christian sympathy with the adverse circumstances of his parishioners who, like those at Arnold, Woodborough, and other large neighbouring villages, were mostly frame-work-knitters. For example, amongst other notices of events, he says, under date 1765—

"The Stocking manufacture very bad last year and this. Scarce half work to be got, or half bellies to be filled. The Lord have mercy on the poor!"

His reference to the extinction of the family to which Rev. W. Lee belonged, would not be inserted without there being conclusive evidence to his mind on the various points included in it.

The Glebe house at Calverton was standing in the reign of Elizabeth, and consisted of one sitting room and kitchen on the ground floor, a chamber over each, and an attic: some addition has been since made to it. The living was then only of £4 yearly value; therefore Rev. Mr. Oliver reasonably suggests that Lee, who certainly ministered there, would not do so as Curate, which has been stated, but as Incumbent; and has no doubt that he occupied for his sitting room the apartment in which these notes were taken by the author. He further stated that according to tradition the first frame was constructed and worked in a building at Woodborough; Lee causing the hose made on it to be sold at Nottingham.

Nothing has hitherto transpired to shew what became of Lee's freehold estate. The brothers who are said to have all been taught by him the art of frame-work-knitting, would be at the time of his invention respectively 15, 12, 9, and James, the youngest, only 7 years old. A certain space must have intervened before the latter could take any part, much less the important part he eventually sustained in his brother's affairs in London and Rouen. He would be 28 years of age when his brother died, therefore that assistance would be quite possible.

There is every reason to be assured from full inquiry at the time, of the accuracy of the petitioning London frame-work-knitters' statement to Oliver Cromwell in 1656, in regard to the origin of the machine-wrought

hosiery trade, and as to the machine "being an English invention by William Lee, Gentleman," (he had early laid aside his sacerdotal character). It was made the subject of strict investigation by the city authorities to whom it was referred; its truth was vouched for by them; and the Protector granted the charter accordingly. The existence of this charter has been long denied; but it is dated 13 June, 1657, and was enrolled in the city archives, 14 July the same year, after examination by a committee, and their report thereon.

Richard Cromwell acted on a petition from the same body referring to the recent charter, in which were again inserted the words "it being an English invention, &c.," by ordering the seizure of forty stocking-frames about to be exported. This was in 1659.

In 1663, Charles II. granted them a new charter on a similar petition from the same body, and in which was repeated the words, "it being an English invention."

Dr. Howel, writing in 1680 his *History of the World*, ascribes the stocking-loom to the Rev. Wm. Lee, "who on an engine of steel, manufactured silk hose, &c."

In 1751, Dr. Deering says, in his *History of Nottingham*,—

"That the inventor of the stocking-frame was one Mr. Wm. Lee, M.A., of St. John's College, Cambridge, and who was born at Woodborough, near Nottingham."

This writer appears to have visited that village and the adjoining one, to learn if anything could be then ascertained as to the personal history of this remarkable man. He subjoins what was probably the result of his enquiry:

"Traditional story says, that Lee was deeply in love with a young townswoman of his, whom he courted for a wife; but whenever he went to visit her, she seemed always more mindful of her knitting than of the addresses of her admirer. This slight created such an aversion in Mr. Lee against knitting by hand, that he determined to contrive a machine that should turn out work enough to render the common knitting a gainless employment. Accordingly he set about it, and having an excellent mechanical head, he brought his design to bear in the year 1589. After he had worked a while, he taught his brother and several relations to work under him; and for some years practised this, his new art, at Calverton."

It is, however, possible that Deering derived this account

mainly, if not from the frame-work-knitters' petition to the Protector, as some think, from Stowe, who in his *Chronicle* says—"In the year 1599 was devised and perfected the art of knitting or weaving silk stockings, by engines or steel looms by Mr. Lee, M.A., of St. John's College, Cambridge. Tradition attributes the origin of this engine to disappointed love and pique against a townswoman who slighted him. She got her livelihood by knitting, and to deprive her of employment he constructed this frame."

Anderson, in the latter part of the 18th century, ascribed the invention to the Rev. W. Lee, M.A., St. John's, Cambridge.

Rees's *Cyclopædia* contains an excellent article under the head of 'Stockings,' by an unknown hand; who, however, was perfectly master of the construction of the machine, an accurate description of which he has given. His account of its invention is as follows:

"This gentleman, Wm. Lee, it is said, was expelled the University for marrying contrary to the statutes of his College. Thus rejected, being ignorant of other means of subsistence, he was reduced to the necessity of living on what his wife could earn by knitting stockings. This gave a spur to invention; and by curiously observing the working the needles in knitting, he formed in his mind the model of the frame which has proved of such singular advantage to that branch of our manufactures."

The writer gives no hint from what source these particulars were obtained.

Blackner in the *History of Nottingham*, published in 1815, says—

"The inventor of this machine was Wm. Lee, the owner of a small freehold estate at Woodborough, the place of his nativity. Deeply smitten with the charms of a captivating young woman of this village, he paid his addresses in an honorable way; but she seemed always more intent on knitting stockings, and instructing pupils in that art than upon the caresses and assiduities of her suitor. He determined therefore to mar her knitting, in order to change her to his views. The former he accomplished in 1589, by the invention of an engine or frame for knitting stockings; a curious and complicated piece of machinery possessing six times the speed of the original mode, and capable of an endless variety of substantial and fancy productions. He gave up the fickle fair one to secure wealth and future fame."

The author gives no authority, especially for that additional particular, of the lady giving instruction to

pupils in knitting, which was a very probable circumstance, from the popularity and profit of the art—facts well ascertained from other sources.

G. Henson gives a somewhat more extended and florid account, in his unfinished work published in 1831:

"A single man, William Lee, a clergyman of the Established Church and curate of Calverton, by the strength of his own natural genius, threw a new light on the powers of production by inventing an engine to knit by machinery; increasing speed twenty-fold. The attempt was new, and had much to discourage it; and he suffered much in accomplishing his arduous undertaking....This gentleman, it is universally said, originated this machine in consequence of disappointed love. He paid addresses to a young woman in his neighbourhood, to whom, from some cause, his attentions were not agreeable; or, as it has been with more probability conjectured, she affected to treat him with negligence to ascertain her power over his affections; whenever he paid his visits she always took care to be busily employed in knitting, and would pay no attention to his addresses; and pursued this conduct to so harsh an extent, and for so long a period, that the lover became disgusted: and he vowed to devote his future leisure, instead of dancing attendance on a capricious woman,.. to devising an invention that should effectually supersede her favourite employment of knitting. He succeeded, and in vain did she (afterwards) try to reclaim his attentions. She found, too late, she had carried her humours too far....The stocking-frame remains in attestation of the greatest triumph of mechanical genius then, or for many ages known."

About the year 1833, Dr. Ure investigated the history and machinery of both the hosiery and lace trades, partly with the assistance (amongst others) of the present author, and gives the result as to the invention in his history to this effect. After mentioning the account of Wm. Lee's supposed expulsion from the University as the result of his marriage, consequent distress, his wife's knitting and his invention of the machine to increase their means of living, Ure intimates his opinion that the following is the more probable statement of the facts of the case:

"It being an ancient tradition around Woodborough, his birthplace, that Lee in youth was enamoured of a mistress of the knitting craft, who had become rich by employing young women at this highly prized and lucrative industry. By studying fondly the dexterous movements of the lady's hands, he became himself an adept; and had imagined a scheme of making artificial fingers for knitting many loops at once. Whether this feminine accomplishment excited jealousy, or detracted from his manly attractions, is not said; but his suit was received with coldness, and then rejected with scorn. Revenge

prompted him to realize the idea which love first inspired, and to give days and nights to the work. This, ere long, he brought to such perfection, as that it has since remained without essential improvement the most remarkable stride in modern invention. He thus taught his mistress that the love of a man of genius is not to be slighted with impunity."

Mr. C. H. Cooper, the late lamented town clerk of Cambridge, and one of the most learned antiquaries of this age, bestowed much laborious research upon the life of William Lee, preparatory to introducing a notice of so distinguished a Cambridge man and mechanician into his work (now passing through the press) *Athenæ Cantabrigienses*. The following extract from that article, which has been obligingly furnished for our use, gives the confirmed opinion of Mr. Cooper, previously expressed by letters from him, as the result of his enquiries:

"William Lee, who was born at Woodborough in Notts., and who is said to have been heir to a good estate, was matriculated as a sizar of Christ's College in May 1579. He subsequently removed to S. John's College, and as a member of that house, proceeded B.A. 1582-3. We believe that he commenced M.A. 1586; but on this point there appears to be some ambiguity in the records of the University. In 1589, at which time it is stated he was Curate of Calverton, about five miles from Nottingham, he invented the stocking-frame."

The writer then quotes Deering's account of the love affair, and its supposed influence on Lee's mind and conduct; and after reciting, very briefly, some of the main incidents of his future life and death, concludes thus:

"The testimony of those who lived soon after him, and the inscription (on his picture) which we have given, will probably be accepted as fair proof that the merit of this important invention is really due to Wm. Lee, M.A., of St. John's College, Cambridge; and therefore we cannot but regret that the materials for the biography of this most ingenious person are so scanty, and that we have been able to add but little to the facts respecting him which were previously known."

In this expression of regret every admirer of great but unfortunate talent must join. But under this dearth of circumstantial information as to Lee's personal life, it is not so much with what Lee was as a man, as with what he attempted and accomplished as an inventor, that at this distance of time it is possible to deal satisfactorily. In this respect there is happily enough known to satisfy reasonable curiosity.

Before proceeding to a description of that singularly interesting process by which Lee arrived at the construction of the stocking-frame, it is proper to state in reference to the lack of personal notices of him just glanced at, that very diligent search has been made at the state paper offices, and at the British Museum, for letters or papers written by or having any bearing upon "William Lee, *the inventor*." Particular stress was laid upon a careful examination of Baker's MS. collection at the Museum; Baker having been himself a Fellow of St. John's, who spent his life in college in making laborious collections of everything curious and interesting connected with it. He died in 1740; and could not fail to collect any existing documents relating to so remarkable a genius as Mr. Lee. In the Catalogue of or Index to these MSS., by four members of the Cambridge Antiquarian Society, dated October 1848, p. 101, Wm. Lee is referred to at letters xix. 314, 8, and at p. 100, a note of Wm. Lee, xii. 224, is mentioned. But, if in the collection, they could not be found after repeated search.

It is not surprising, that with such large results as those flowing in a constantly widening stream from a source so comparatively obscure, much romance should during late years have been mingled up. In this instance the romance has been clever and captivating, and pictorial art has illustrated the tale with greater talent still. Whether the imaginative has not too far trenched on the domain of the real, so far as it is known, the reader of this chapter will be enabled to decide.

It is intended that all that is positively known of Lee, as well as all that has an indirect bearing on the salient points of his career, shall be recorded here, so far as is possible, therefore the following principal incidents of two popular stories founded upon Lee's invention are appended.

The exhibition of a picture in 1847, painted by A. Elmore, A.R.A., a few years ago, called the "Origin of the stocking-loom," was accompanied by an explanatory paper; of which, as it contains positive assertions on this subject that do not admit of proof, a short abstract will be given. This is the more needful, as the

work was in its execution highly creditable to the artist, and consequently has become extensively known and admired:

"Wm. Lee was a native of Woodborough: entered St. John's College, Cambridge; whence he appears to have been expelled in 1589, for marrying against the statutes. Whether he had attained a fellowship, for which then, as at the present day, matrimony would constitute a disqualification, or whether as an ordinary student he subjected himself to expulsion by entering upon that state, we have not at hand the means of ascertaining. It is enough for our purpose to know that *he was expelled;* and being without means, was driven to take up his abode in a wretched cottage with his young wife and infant child.... There is in the scene, the young fair wife, for whom he had lost all; and the infant, whose coming enhanced their perplexities, which it yet consoled....The painter has seized the point at which the poor student conceived the idea, suggested by his wife's occupation of knitting, of a machine for making stockings. The moment in which a new fact in Art or Science flashes on the mind, is perhaps the happiest in the life of an inventor. But as it was the first pleasure, so it was the last, that resulted to him from it. He settled at Nottingham, and laboured five years in carrying out his invention. He solicited the patronage of Elizabeth: but her masculine mind doubtless regarded the invention of stocking weaving by a *man*, with contempt; for his petition was unnoticed. He had as little success with the trifler, James I., and Lee passed over to France, where, so far as patronage was concerned, he was more fortunate. Henry IV. and Sully warmly espoused his cause, and matters went prosperously with him for a while. The death of his royal patron, however, flung a cloud over his prospects. He shared in the persecutions which befel the Protestants in France; and finally died of grief and despair in Paris....Many a heart has been literally broken on the *wheel*, whose revolutions have made the fortune of thousands.."

About the time when the subject of this invention was thus brought prominently before the public, a novel, professedly historical, in three volumes, was published under the title of the *Nut Brown Maids*. The author speaks of obligations to Fuller's *History of Cambridge*, Burton's *Anatomy of Melancholy*, Charles Knight's *Old England*, Cook Taylor's *Romantic Biographies of Queen Elizabeth's reign*, and Lucy Aiken's *Elizabeth*. But notwithstanding this array of names, the work shews, in regard to the life of its hero, Lee, how far imagination may travel apart from the pathway of ascertained facts; and it is moreover in striking contrast as to almost every important event stated in its course and in its denouement, with the above relation of the pictorial biographer.

As these volumes have been extensively read, and are certainly "curiosities in literature," at least to the frame-work knitting community, an analysis, but the briefest possible, is here given:

"A visit of Queen Elizabeth to Cambridge, introduces Lord Hunsdon, son of Lady Mary, sister to Anne Boleyn, first cousin to Elizabeth. His dissimulation and Latin, alike bad, and his custom of swearing, made him appear a worse Christian than he was. Wm. Lee, of kin to the Champion Lee of Ditchley, destitute of patrimony from confiscation, is at college; 23 years old; of pale, hard, cold aspect; well knit frame, and an inner fire. He is offered promotion in arms by his sovereign, and declines it. The only son of a widow, she starves herself to sustain him at College. Cicely Yorke, daughter of a man of good family, had compassed the new and intricate manner of stocking knitting; 'the looped invention of the Low Countries.' So she sat 'knitting Flanders hose, her many meshes of reason and memory, picking up and letting down.' With her Lee falls in love, and marries her secretly. She continues to knit in her lowly retreat. He preaches in his College, Trinity; and hopes for a curacy, but is disappointed. Dean Whitgift discovers the union on finding them together; it is avowed, and they go to Nottingham, to which both are strangers. In the upper story of a high gabled house leading to the castle, Lee proposed to receive scholars, but from his reserved manners, he found himself after some time with but three pupils, and bemoaned his shipwreck. His wife then undertook to teach girls with a brave heart: but her school also proved a failure. The author here speaks of the noisy, ramshackle artizans of this weaving town. He moreover says, 'It is a well accredited fact, that Cicely maintained her husband, children, and herself, by that art of knitting, which she had learnt in her maiden home.' Their lot realized the legend of Champion Sir Henry Lee, the head of his house, 'More faithful *than* favoured.' Wm. Lee recovers his spirits, draws patterns, buys planes, files, and pincers, and is in fact constructing the stocking-loom. At length he shews his wife a stocking wrought upon it, saying, 'mayhap, they will call them Will Lee's hosen'. To his chagrin, she regrets his success as detrimental to the hand-knitters' employment. The news of the machine spreading abroad, brought crowds to see the loom, on which a meshed web shaped to the human form was made. Demoniacal power was strongly surmised; and the overthrow of even the old weaving-loom predicted; so an assembled mob in their fury 'smashed the machine,' amidst cries of 'No mock weavers to ruin our own old Nottingham cloth.' But the idea of the machine 'once created, could not be *un*created.' Lee is described as appealing to Elizabeth, and presenting her with silk hose, which he had wrought on his frame. She promises him a patent of monopoly, and her support; and Lee 'enjoyed a blessed peace and safety under her all-powerful protection.' He remodelled and improved his loom; and carved on the beam, 'More faithful *and* favoured.'"

Upon these legends it may be remarked that Lee was certainly *not* expelled from either University. There is

no reason at all to believe he was ever married, but many things concur to lead to the contrary opinion. Both these writers take Lee with a wife to Nottingham to reside. There is not a trace of his ever living there, and of course none of the lonely construction or riotous demolition of his first frame there. Had any one of these things occurred at Nottingham, the fact would not have remained till now unwritten in the well authenticated annals of that place.

Even these do not exhaust the number of notices of Lee and his machine, which have been made public. Those that remain to be cited, refer chiefly to its being claimed as a French invention or occurrences which are said to have transpired there. Nicholls, in his *History of Leicestershire*, vol. I. part II. p. 621, in a note says, that there is prefixed to a poem published by T. Baldwin of Hinckley 1776, and addressed "to the hosiers, frame-work-knitters, and frame-smiths, of the several counties of Leicester, Nottingham, and Derby, &c., on the Rise, Progress and Present State of the ingenious Art of Frame-Work-Knitting," the following historical note:

"The English and French have greatly contested the honour of the invention of the Stocking-Frame. But whatever pretensions the French may claim to this invention, it was certainly invented by William Lee of St. John's College, Cambridge, in the year 1589. It does not appear that Wm. Lee ever received any hint from any person whatever, relative to this great invention. But, according to tradition, Mr. Lee paid his addresses to a young lady of great beauty and fortune; and one day he surprised her in a grove, knitting a fine silk stocking. It was in this grove that the young lady gave Mr. Lee an absolute refusal of her hand; which so offended Mr. Lee, that he declared he would invent a machine that should be a means of spoiling the knitting trade. So, it seems, either love or revenge was the first moving cause to this great invention.

However, as soon as Mr. Lee had completed his stocking-frame, he petitioned Queen Elizabeth for her royal encouragement. This petition was rejected. Therefore, despairing of success in his own country, he went to France, and applied to Louis XIII. for his royal encouragement and protection. Accordingly, Mr. Lee continued for some time at his court; and the French King was so pleased with the ingenious art of Frame-Work-Knitting, that he had a frame made of silver for his own use, and really learnt the art of Frame-Work-Knitting himself. And the said silver frame is kept in Paris, as one of the greatest curiosities in France. After the King had set the royal example, most of the French nobles learnt it. But Louis XIII. as a greater encouragement, issued out an order that all persons that were willing to serve an apprenticeship to the art, should be allowed

to wear a sword; which honour no other mechanic is allowed in France.

Some years after, Mr. Lee received an invitation to return to his native country, which he accepted; and soon after, the art of Frame-Work-Knitting became famous in England; and Charles I., with a great many of his nobles, learnt it. And it is said, that as Mr. Lee had gained so much honour at home and abroad by this invention, his former lover nobly gave him her hand, and crowned his wishes and ingenuity with her person."

Nicholls closes the note by judiciously remarking, "I quote this paragraph as matter of curiosity, without vouching for its historical exactness." No doubt, it includes some corroborative points in regard to the invention being due to the William Lee, to whom it has been generally attributed. All that relates to Louis XIII. and the stocking-frame in his court and times, is apochryphal. If founded in facts, they would have been related by eminent French writers who are silent upon them. Charles I. and his nobility were otherwise engaged than in stocking weaving. The testimony to Lee's death abroad and its melancholy circumstances, is too strong to be shaken by the contrary statement above quoted. This, with the consummation of Lee's happiness it professes to record, may be probably the result of popular and natural desire that the genius and affections of such a man should have been crowned with public honours and the pleasures of domestic life.

In Rees' *Cyclopædia*, the writer of the talented article upon "Stockings," states that the English and French have much contested the invention of the stocking-loom; and goes on to give the following extract from Chambers' *Dictionary of Commerce*, which embodies the view of M. Savary on this subject:

"Waiving all national prejudice, the matter of fact seems to be, that it was a Frenchman who first invented this useful and surprising machine; and who, finding some difficulty in procuring an exclusive privilege which he required to settle himself in Paris, went over to England, where his machine was admired, and the workman rewarded according to his merit. The invention thus imparted to the English, they became so jealous of it, that for a long time it might not be exported under pain of death, or communicate a model of it to foreigners. But a Frenchman, by an effort of memory and imagination, first set it up in Paris, in 1656, upon the idea that he had formed of it in a voyage to England; and this loom has been the model of all those since made in France, Holland, &c."

The writer of the article goes on to say:

"This account seems erroneous, as it is now generally acknowledged that this machine was mounted, in 1589, by Wm. Lee, M.A., of St. John's College, Cambridge, a native of Woodborough, near Nottingham."

M. Savary says, in support of the claim of France, that "the English cannot give the name of the inventor." In this he is mistaken. Thoroton had published it a hundred years before, as has been seen already. But M. Savary himself does not give the name of the person who is said to have invented and carried the frame to England, or of him who took it in his memory back again to France. Roland de la Platiere states that:

"He heard at Nismes, in Colbert's time, the first loom was smuggled from England, at the risk of life to several persons, by one Cavellier, and introduced into France; and that in fifty years there were some thousands of these looms in Nismes and its neighbourhood."

It must be remarked, in passing, that though it was illegal to export machines from England, the penalty never was death; in 1696, by an act of William III. a fine was levied and the property confiscated.

M. Savary says, no doubt accurately, that the stocking manufacture was first established in Paris, in the Bois de Boulogne, by John Hindret, in 1656. The first French encyclopœdists ascribe the invention to the English; as did Voltaire in "Le Siecle de Louis XIV." Berlin, 1751, 12mo. vol. II. p. 118:

"On sait que le Ministere acheta en Angleterre le secret de cette machine ingenieuse, avec laquelle on fait les bas dix fois plus promptement qu' a l'aiguille."

This opinion in France remained undisturbed for a long time. Beckman, in analysing the statements to the contrary, which he does at some length, thinks them weak and unsatisfactory; refers particularly to the London frame-work-knitters petition to Cromwell; and remarks on their statement of the author and circumstances of the invention as being an English one:

"That every thing relating to it must have then been fresh in the memory of those who drew it up, and that every circumstance could then be easily examined, and the petitioners must have been sensible that any misrepresentation for which, however, they had no reason, could easily be contradicted. My object," he goes on to say,

"is merely the question, Who was the inventor, in what country, and at what time, did he live? I can say, after the most diligent research, it does not appear subject to any doubt....To perfect the practice of hand-knitting was a great thing: but not so astonishing as the invention of the stocking-loom, which was not, like most great discoveries, the result of mere accident, but of talent and genius.... It appears to me, proved beyond doubt, that the stocking-frame was invented by Wm. Lee, an Englishman, about the end of the 16th century."

To this conclusion, it is most likely the great majority of his readers will, with the present writer, unhesitatingly come.

CHAPTER IV.

THE STOCKING-LOOM, AND REV. WM. LEE, CONTINUED.

The mechanical formation of a web, constructed of the knitting mesh, is so different to the simple passing of the threads in the common weaving-loom, the only contrivance for producing a tissue then known, that to effect it required original power of analysis and combination, of an unusual kind. Forces must be applied in ways and for purposes which probably before had never been thought of, certainly never attempted. And instruments, to operate like human limbs and joints, had to be devised. The difficulties were immense. Lee, a student and clergyman, could have little theoretic and no practical knowledge of mechanics, and there were few persons to whom he could apply for aid.

Having become curate in the Church of his native village of Calverton, his first essays were made there; and either from the artizans of that village or the superior ones to be found in the neighbouring county town of Nottingham, he must look for the manual skill in working upon wood and iron, which would be necessary in carrying out his design. It has been already stated that there is no sign of his ever sojourning, much less living at the latter place. It is expressly said that the machine was made, as well as afterwards worked at or near Calverton. His plan would no doubt be, to secure the most clever and teachable artizans of each trade, willing to do his work, that Nottingham could then supply; and thus step by step make quiet progress under his own eye, close to his own home.

It has been an old saying in this district, "The little smith of Nottingham, can do the work no other man can." But this vaunting proverb had then not been realized, whatever by forge and hammer, file

and plane, may have been since done there. Yet it was already well known for superior manufactures in iron and steel articles. Three of its streets were named from these trades:—Bridlesmith Gate was so called from its being the mart for bits, bridles, snaffles, and other horse furniture. Girdlesmith Gate, from girdles and steel ornaments. Smithy Row speaks for itself. The smiths also supplied Nottinghamshire and the neighbouring counties with "plough irons, coulters, shares, stroakes, harrow-teeth and nayles." The reason assigned was "the plenty of coals to be got, and of iron made in these parts." It seems also that wood-work in turning, carving and cabinet-making, was prosecuted in Nottingham and the northern parts of the county with much success. The excellent close grain of the wood obtained from Sherwood forest made it capable of being used for the finest purposes, and was just at hand at Calverton; so that part of the inside work of his loom as well as the outside could with safety be make of that material. One need not wonder, therefore, to read that "his first machine was almost wholly of wood."

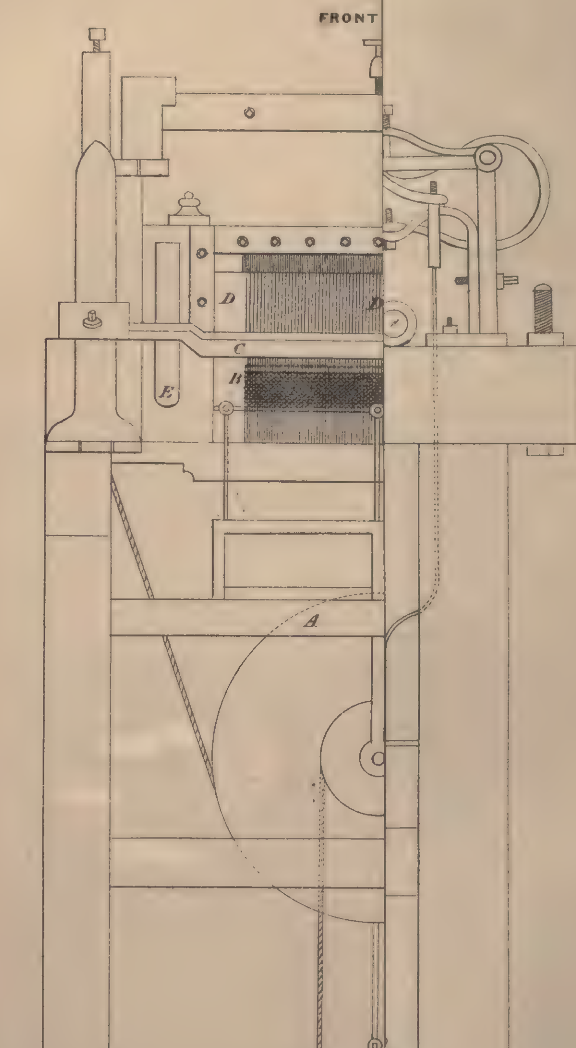
During the three years in which it is believed Lee employed himself in prosecuting his invention, he is said to have used up a large portion of his patrimonial means; even to suffering privation, while labouring with intense zeal and anxiety in efforts, often very seriously baffled, but as constantly renewed; and which he believed would enable him to realize an immense fortune. These expectations absorbed all other avocations, interests, and affections. To realize them he neglected every other means of existence; finally, on the completion of his great work, resigning his duties and position as a clergyman. If upon his success, he also gave up the strengthening and ennobling influence of high religious principles, he purchased it at too dear a rate: for they alone could guide him through the waywardness of court favour and neglect which he was afterwards to encounter, and sustain him under the future and final disappointments that awaited him.

Wm. Lee had a brother, James Lee, who there is little doubt was practically instructed during the putting the frame together in its use. He seems to

have been his brother's best workman in it, and his constant companion and confidential assistant throughout the remainder of his life. By them other relatives and connections were taught the art of frame-work-knitting. They thought the employment so honourable, as to wear silver work needles, suspended by silver chains at their breasts. This practice was continued by frame-work-knitters, so late as the reign of Queen Anne. The frame was completed in the year 1589; and worked, for probably about two years, at Woodborough or Calverton, with varying profit. The prejudice in favour of hand-knit-hose had to be overcome, while finding a market for those wrought on the machine.

The course which the invention of the stocking-frame took, from its first inception in the mind of Lee to its completion, was not left on record by himself, or any of his contemporaries. But the machine being so soon transferred to London, and to a particular spot Bunhill-fields Saint Luke's, from whence its use radiated amongst other parts to Spitalfields, and after a few years to Godalming in Surrey, added to its forming at an early epoch the basis of an incorporated London trade company, raised the curiosity of frame-work-knitters, then in the first class of skilled workmen, in order to ascertain the steps by which an *engine* so wonderful to the people of those days, could have been completed. Consequent on the inquiries thus excited, the elder stocking-makers and hosiers in and about London, where the manufacture was for a long time principally carried on, were never tired of relating the difficulties encountered by Lee, and the methods he adopted for overcoming them.

The information upon this subject given by Henson, cannot, in the main particulars, be far from correct; the nature of the machine and its processes corroborate its general accuracy. He states it to be drawn up from the accounts received in answer to enquiries put to Mr. Hardy, Twister's Alley, Bunhill Row, London, who was apprenticed to the stocking-making business in 1711, and died in 1790, aged 90; and from Mr. Wood, Godalming; also, from an ancient frame-work-knitter, who was apprenticed in Nottingham, in Queen Anne's



A. Workman's S Presser.

B. Needles or h

C. Presser. ich sinkers D are suspended.

W. Metcalf Litho

reign, and who died in Collins's Hospital, Nottingham, aged 92. All agreeing mainly in their statements, and confirmed, as to the machine, by the working parts depicted upon the shield of the arms of the frame-work knitters' company, adopted at their first incorporation in 1657, and shewn by the engraving given in this work.

About eighty years ago, a statement was made by an anonymous writer, relating the course taken by Lee in constructing his frame. Henson's account coincides generally with this; the differences are such only as would lead to the conclusion, that they came from separate but authentic sources. It is more than probable that Henson had no knowledge of the previous statement, though the writer of it was practically acquainted with the parts and operations of the stocking-frame, as well as conversant with the hosiery trade. He does not say from whence he derived his information.—On the whole, it may be reasonably concluded, that the main facts in Lee's course of invention, have been handed down. The following description embodying them is chiefly drawn from Henson:

"The web of a stocking is knitted by hand, on three or four long pins, of a row of loops, and in a round shape; it seemed to Lee impossible to construct a machine to make a *round* web, having as many needles as loops, in the circumference of the hose. Pondering on the difficulty, he one day saw his mistress knitting the heel, using two needles only; one held the loops while the other was employed in forming a new series. It struck him he could make the web flat, or in a *straight line* of *loops;* and when thus made, *join the selvage* by seaming them together; and thus make it round. He was then led to the idea of throwing a thread across a long elastic hook, the point of which should be pressed down into a hole in the stem of the wire, and thus loop at pleasure. He bored the holes, and tried to insert the point; but though he could make the loop on the wire (since called a needle), it would not slide easily over the inserted point. At length he thought of the groove instead of a hole. But here tools failed him in making the groove. He flattened the wire at that part, heated it, and turned the edges towards each other, and spoiled much wire in the ineffectual attempt. Afterwards, by using a three-edged file, he cut out the groove. After spending a long time in making these hooks of various shapes, he made the long bearded hook or needle, fit for his purpose.

In his first attempt at looping, he inserted firmly into a piece of wood a dozen of these needles, eight to an inch; fixing this piece of wood upon a wooden frame-work, (hence the name *frame*), and

endeavoured to make a succession of loops upon them by hand, which he finally accomplished, knitting on this row of hooks a pair of garters in this manner.

The next point needed, was to form and fix a wooden bar (the presser) to press down at one movement all the barbs of the hooks into the grooves, using the one hand to bring forward the loops, while he put all the beards down into the grooves with the other; and so by passing the row of loops over the beards and needle-heads, he formed row after row of loops to pass upon the previously made rows, till several inches of web were produced.

He now tried so to deal with the single thread with which his web was to be made, as to gain a sufficient length of yarn in each loop; and so to form the succession of loops, across a series of needles, placed in a straight line. All attempts to do this by rows of pins fixed upon levers, acting at the head of the needle, where it is bent back to form the hook or beard, proved abortive; so he was driven to attempt it at the stem, which, after many efforts, was effected in a most ingenious manner by the construction of what are called the 'jack' and 'sinker.'

The jack is a lever working freely on a wire, upon which it is balanced. In Lee's frame these were of wood, one to each needle, and the whole row of jacks were kept in place by working in a comb. In the round head of the jack is a slit from which the sinker hangs, and works perpendicularly. The sinker was made by Lee from a thin plate of tin, and is so shaped, as by passing between the needles to carry down as much thread as to form a loop between each pair, then to carry them forwards under the needle-beards and close to their heads; and after the presser had placed the points of the beards in their grooves, the sinkers brought forward the web of loops already formed, and passed it over the row last formed; then took the work back to the stems of the needles ready for a new course. To devise one instrument shaped so as to perform so many essential operations was a marvellous thing, and was only accomplished after many unsuccessful efforts. Still more wonderful, that it was so perfectly adapted as to continue, without material change, in use to the present time.

The jacks, when the sinkers were attached, were lighter behind than in front, so he placed a row of light springs at their tails to hold them from falling forwards, except when wanted to form a fresh row of loops. Then they, following the thread thrown by the workmen each way, were forced down in rotation by an iron instrument of suitable shape, called a slur cock; which, pulled by a string attached to treddles, runs backwards and forwards on a bar, and by striking against the jack tails in succession, cause the hissing noise heard in frame-work-knitting.

The whole inside of the machine was first made to run on two trucks only; since, on four—a great improvement as to labour and speed. For the entire machine has to be moved forwards by the hands, then made to sink by means of a central spring; then to rise and to retreat to its former position; all to enable the sinkers to do their successive duties. These movements must be seen to be quite understood; and the skill of the workman is shewn in their rapid performance by his hands and feet, governed by his eye."

There were in Lee's frame only jack sinkers, and the half jacks which connected the movements of the jacks, combs, and springs, were fastened to the verge bar, which stopped the heads of the jacks when pressed up by the locker bar, after they had fallen. This locker bar was worked by the foot, as was the frame bar when sinking to bring the thread to the heads of the needles. After three years Lee made the first actual course of loops upon his frame.

He was not long in learning how, by removing loops from time to time on the outer sides of the web to the next needles inward, to gradually narrow it, and by a reverse process to widen it.

But here a great and seemingly insuperable obstacle presented itself, arising from the peculiar shape of the heel and foot of a stocking. He had observed that the hand-knitter on coming to this point of her labours, first knitted the heels alone, and then proceeded to form the remainder of the instep and foot. Misled by this he worked the heels alone, and in order to avoid pressing the instep off the needles, he brought the instep under the needle hooks or beards by hand before pressing in every course. It is said that months elapsed before the method of working them together was devised by him.

Thus at length, by perseverance, his efforts and hopes were crowned with success, and William Lee, the clergyman, became the first frame-work-knitter.

The peculiar shape of the needle with the barb turned back diminishing to a point is shewn at Plate III. with a section of the presser ready to act on it. The needle is made of carefully selected and tempered iron wire, and, though the result of simple operations, requires to be thoroughly well finished by experienced workmen. These form a separate branch of business.

The sinker is seen appended to its jack (Plate III.); as the sinkers have to pass easily and freely between the needles, they are made of sufficiently thin plates of iron cut to exactly the same size and shape in moulds. They are carefully smoothed so as not to injure the thread on which they operate. Making them is also a distinct business.

The frame-smith makes the jacks to an exact size

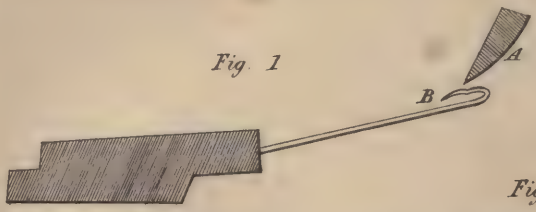
and with great care, as also the combs. To make the jack springs is usually a separate business.

The operations of the stocking-maker when seated in his frame, may be described as consisting of eleven movements, in the formation of one series of loops or a 'course.' These are as follows:

"Throwing the thread from a bobbin over the hooks or 'needles' by hand. Drawing the slur by one of the treddles, to force down the jacks and their sinkers, and so to form loops between every other pair of needles. Sinking the lead sinkers down on the thread, to divide the loops between all the needles; locking up jacks at the same time by the thumbs; and so equalizing all the loops by these cleverly combined movements. Bringing the loops thus formed to the needle-heads. Throwing up the frame, assisted by the strong central spring; leaving the loops at the needle heads, and the work at the stem, to be pressed over, in forming the new course or series of loops. Then, putting down the spring bar or 'presser' by the foot on the middle treddle; and, putting forward the web already made, upon the needle beards, which are now pressed into the grooves of the needles. Then, letting the presser rise, and at the same time, bringing the web over the needle heads. Bringing down the frame to the bottom standard to catch the work with the nebs of the sinkers, which are for that purpose made in the shape of a long arch. Taking back the web by the nebs of the sinkers, holding the frame firmly down. And, finally, letting the frame rise to the catch of the copens, holding the thumbs firmly to the thumb plate; and then quit the thumbs for another course. The slur is moved for one course, to the right; and for the next, back to the left."

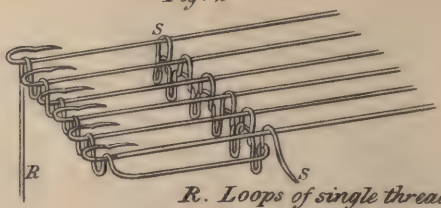
While the hands are thus busy, and the feet moving at the rate of one hundred yards in a minute, the eyes must keep watch over the needles as to their soundness and uniformity, and upon the work, that it be free from blemish, and irregularity in the lines of loops traced down its length. In narrow frames the number of needles is from 150 to 600, according to guage; in wide ones there are sometimes 1500. Fashioned work is favourable to the hand workman, by relieving him during the shaping of the stocking and other operations which require change of labour and position of the body. Wide hand-frames on which usually the unfashioned work is made, which has to be shaped by the scissors, are consequently very trying. Nevertheless, the constancy of muscular motion is favourable to the health of the stocking-maker. If the shop in which he labours is sufficiently warm and well ventilated, this employment is more desirable than many others in this important

Fig. 1



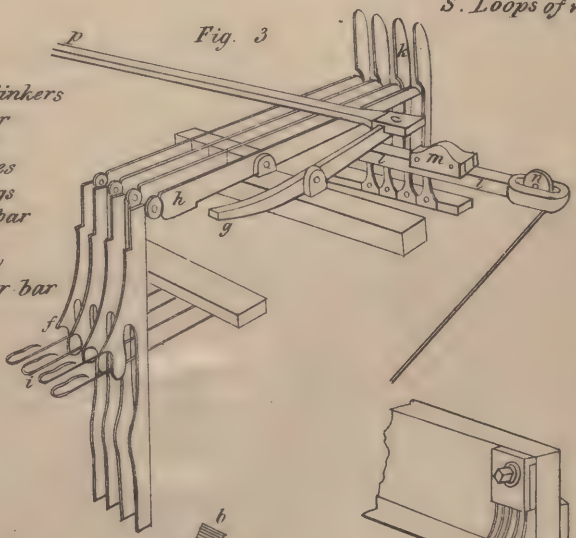
A. Section of Presser-bar to act on B Needle beard.

Fig. 2



R. Loops of single thread
S. Loops of web to pass over beards.

Fig. 3



f. Jack Sinkers
g Locker
h. Jacks
i. Needles
k. Springs
l. Slur-bar
m. Slur
n. Pulley
p. Locker bar

Fig. 4

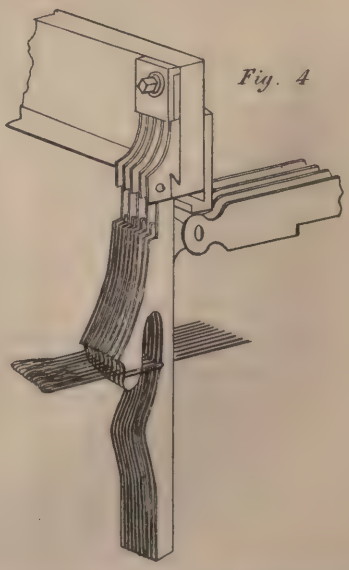
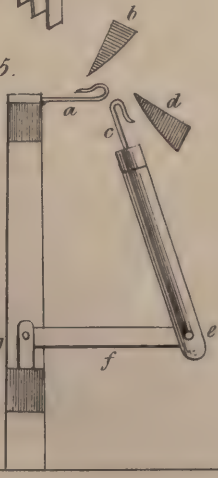


Fig. 5.



SECTION OF LEE'S FRAME.

a. Needles
b Presser

STRUTT'S MACHINE.

c. Needles
d. Presser
e. Moveable Joint
f. Vibrating Arm
g. Standard

W. Metcalfe, Litho.

particular. The failure of sight as evidenced by the early use of spectacles, is however very common, especially so in the case of frame-work-knitters occupied in making hosiery of fine qualities.

By this process instead of, as by skilful hand-knitting 100 loops formed in a minute, on Lee's first frame 5 to 600 were made, and upon the frame afterwards adapted by him so as to produce silk hose, 1000 to 1500 loops were produced in the same space of time. It was not long before greater width, fineness, and speed of the machine, were attained. At the time of the first invention and even now, to those who are not accustomed to examine the construction of machinery, the stocking-frame presents the appearance of complication in its swift movements. A youth ten or twelve years old soon learns to work in it. The author at thirteen years of age produced three pairs of fashioned women's twenty-six guage full sized hose between six in the morning and nine in the evening of a summer's day in 1808. There are, in reality, no complicated or difficult movements in the stocking-frame, almost the whole are merely those of levers moving on their respective fulcra, excepting those of the carriage, which gives horizontal motion to the jacks, and a perpendicular one to the sinkers; and the alternate motion of the frame backwards and forwards on its four wheels. But the machine requires care and experience to keep it in good order. This arises chiefly from the small compass in which a number of moving parts must be placed to work. Owing to this, the needles, unless cautiously handled and kept with the utmost nicety in line and equidistant, are frequently bent or broken. The sinkers which must be very thin are easily injured. As they must pass freely, both in a perpendicular and in a horizontal direction between the needles in a very limited space, the slightest deviation from being truly and squarely placed, unavoidably injures other sinkers or the needles next to them. When a workman, ignorant of mechanism and too impatient to wait for a remedy from another, attempts to rectify defects, he often unfits the machine for working at all, until thoroughly repaired. This, together with the necessary wear and tear of machinery,

has caused a class of mechanics to be employed, called smiths or *setters up*, who act as constructors of new frames and repairers of old ones. Inferior workmen often necessitate a *recruit* (a thorough repair) of their frames in three years: many however are so worked as not to require it in less than ten or twelve, and we once knew a steady and clever frame-work-knitter, sell his frame at the end of twenty-five years, never having had a recruit, nor then needing one, a singular instance of care and the efficacy of "the stitch in time." The average is about seven years.

Having formed expectations, proportionate to the profound thought and skill shewn in the conception and completion of his machine, and to the consciousness he seems to have felt, that it was calculated to administer greatly to the comfort and advantage of his countrymen, Lee removed it to London, with the intention of seeking the approval and countenance of his sovereign. His brother and other workmen, his relatives, went thither with him. When the invention of a complicated knitting-frame became known there, it was thought to be an almost miraculous event.

The nation was at that moment nearly delirious with joy, at being delivered from threatened invasion by the Spanish Armada. Lord Hunsdon had commanded a main body of the army raised upon that occasion. He was also a near kinsman of Elizabeth. To him Lee made known his desire to exhibit this wonder-working machine, and shew its method and powers in her presence. The whole court seems to have been filled with curiosity upon the occasion. Elizabeth herself, having heard the news, and received Lord Hunsdon's request on Lee's behalf, was not indisposed to accede to it; and at length attended by Hunsdon and his son, Sir William Carey, she repaired to Lee's lodgings in Bunhill-fields, at which place he had set up the frame. Either himself or his brother James had the honour there of working his machine before their sovereign. The Queen expressed her sense of the ingenuity displayed by the invention, but to Lee's great mortification shewed her marked disappointment, that instead of fine silk hose as she had expected, the production was a

coarse worsted-stocking. Indeed it was only eight needles or wales to the inch in width. Notwithstanding this untoward circumstance, Lord Hunsdon had faith in the ultimate importance of the enterprise, and pressed this conviction upon his mistress, begging that a patent of monopoly might be issued to the inventor. But most probably for other and important state reasons, besides the one she is said to have avowed, the influence of her highly valued relative was, on this occasion and afterwards, unsuccessful. Elizabeth's answer to Lord Hunsdon on his intercession for Lee, is thus related:

"My Lord, I have too much love for my poor people who obtain their bread by the employment of knitting, to give my money to forward an invention, that will tend to their ruin by depriving them of employment, and thus make them beggars. Had Mr. Lee made a machine that would have made *silk* stockings, I should, I think, have been somewhat justified in granting him a patent for that monopoly, which would have affected only a small number of my subjects; but to enjoy the exclusive privilege of making stockings for the whole of my subjects, is too important to be granted to any individual."

After much search of the public records and in other quarters, no patent of Elizabeth to Lee can be found, nor the record of any one granted to him. His followers for ages denied there ever was one. And the account by Henson of many parchments and papers being destroyed on the death of Mr. Seagrave, town clerk of Nottingham, "amongst which was one in a tin box having a large seal, on examining which" (the relator, one Twells a tailor, says) "I found it was a deed of patent, granted to Mr. Wm. Lee, for the use of the stocking-frame," has little air of likelihood about it. How came it there, and after two hundred years enquiry after it, how could it have remained unnoticed and even unknown, in the hands of the public officer of that town, which had become commercially important by the use of this very machine? Henson's supposition is that Seagrave obtained possession of this document, during the disputes respecting the charter of Charles II., in 1753. It is not easy to imagine what motive there could be on the part of any descendant of Lee, and still less on that of the Frame-Work-Knitters' Company, to part with this document; or of the Nottingham town

clerk to conceal it, while in his possession, if it ever were so.

So great was Hunsdon's confidence in the value of this invention, and so high his estimate of the profit to be derived from it, that he bound his son by deed of indenture as an apprentice to Lee, that he might learn the art of frame-work-knitting, and thus made him a guarantee to Lee for the security of his invention, as well as to obtain for himself a claim to share in the large anticipated profits. In this manner, Sir William Carey, a knight, the son of a peer and of the royal blood, became one of the first stocking-maker's apprentices. His father no.doubt furnished the greater part, if not the whole of the funds, expended in constructing the next and some subsequent frames.

Lee, though chagrined, was not daunted by the Queen's reply. He determined to fulfil the expectation she had expressed, and at once proceeded to construct a machine, on which silk hose could be made. This was a frame with twenty needles to the inch, requiring a comparative reduction in the thickness of the needle wire; and the substitution of iron for wood jacks, and sinkers so much thinner, that five should work in the space occupied by two in the first machine, with all the other internal parts to correspond. The principle of the machine was unaltered, but its construction in those days was rendered, by this change, so much more difficult, that it was only by his own strong will and the aid of his talented brother James, and their skilful and faithful colleagues, that this notable feat was accomplished.

He now proceeded to make silk hose. Hitherto he had experienced the mortification which was to be the lot of many future inventors. "Because he had not accomplished everything he had done nothing." This silk-hose-frame had been very costly in time, labour, and money. It was not completed till about 1598, which has been taken by some writers, as the date of the invention of the original machine, instead of its successful adaptation to the wishes of this imperious Queen, and the requirements of her expensive courtiers. Lee presented Elizabeth with a pair of silk hose thus

produced, which she accepted with many praises for their elasticity and beauty of texture. But his prospects were not improved thereby; neither patent nor money were forthcoming to do honour or bring profit to the inventor. He discontinued attendance at court, and employed himself sedulously in the construction of more frames, being thenceforth seldom seen any where but in his workshop. Of these he erected nine which were worked by his relatives and apprentices; upon them it is probable he expended all his remaining means.

In 1603, he saw his great but politic and parsimonious sovereign laid in the grave. On the accession of her successor, Lee's hopes of court favour and of a patent revived, especially as it was known that before leaving Edinburgh, James had borrowed a pair of silk hose from the Earl of Mar, saying, "Ye would not have your King appear like a scrub before strangers." But again he was disappointed. In this matter Cecil does not appear to have exercised his usual foresight; or he was thwarted in regard to fostering so promising a manufacture. It is said, but by one writer only, and that a recent one, that Lee worked his frame also in the presence of James: but it is unlikely. After the death of Lord Hunsdon and his son, meeting with continued neglect, he fell into a deep melancholy. Upon which Deering quaintly remarks—

"He shewed an experiment in this kind of workmanship; offering the discovery to his countrymen, who, instead of accepting the offer, despised him, and discouraged his invention. Being thus discountenanced by his native country, and soon after invited over to France, with promises of reward, privileges, and honours, by Henry IV., he embraced the seeming fair opportunity, and went himself, taking his brother and nine workmen, and as many frames, to Roan (Rouen) in Normandy, where he wrought with great applause."

These offers were made by Sully, the celebrated Marquis de Rosny, a special envoy to the English sovereign, who, with the design of assisting to revive the decaying manufactures of France, thus desired to take advantage of the neglect of Cecil. Lee at first hesitated to accept them, because of the tendency to religious persecution in France; but at length he determined to close with the ambassador, and went thither. On arriving and fully establishing his machinery there, he

was called up to Paris, and presented by Sully to Henry, meeting with a gracious reception. This, added to his successful commencement of operations at Rouen, once more raised hopes of good fortune, and he was fast rising into note. While waiting in Paris, expecting a special grant of privilege, and an arrangement by the Minister for the enlargement of the business at Rouen, the assassination of Henry IV. by Ravaillac took place, destroying Lee's position and his hopes at one fell blow. The Minister having resigned his office in disgust, Lee found him retiring from Paris to his estates in the country. The Regent, Mary de Medici, withdrew her protection from Lee; he became suspected at court on account of his Protestantism; his fortitude forsook him; he fell into poverty and distress, and a deeper melancholy than that which had haunted him in London. Finding himself unprotected in a foreign country, and left to bear the pangs of a deeply wounded spirit alone, he sent a message to his brother James to come to him from Rouen. But it was too late: for before the arrival of his brother, the great inventor of the stocking-loom, almost an outcast from his native land, and an alien in France, after nearly twenty-five years of deferred hope, had died in Paris of a broken heart, and was already buried there. This event took place in 1610. If England had the honour to give him birth and education, France, from the just appreciation of his merit by her great sovereign and still wiser statesman, gave him the only royal patronage he ever obtained—and a grave.

It has been stated, that there is absolutely nothing in that which is known of Lee's life, to justify the idea that he had a wife or a child to cheer and animate him through any part of his arduous and eventually saddened career. Had there been such, some trace must surely have been left of the fact in the relations, however brief, of his expatriation, his disappointment, and especially, of his death.

No reminiscences have survived the intervening centuries descriptive of Lee's personal appearance, his manners, his natural disposition, or his general conduct and habits. Born in the middle ranks of life, and

educated as a gentleman with the learning of a studious collegian, he must have been fitted to take a part in the high society amongst which he frequently moved. By the boldness of his claim to the notice of Elizabeth, and his unquestioned success, he became known in the circle of gifted men who surrounded that keen-eyed princess, as the first English mechanician of his own or any preceding age. So far his ambition was gratified. Still more so, when the great merit of his invention was acknowledged in the presence of the court of France. But pecuniary reward depended on the smiles of fortune, of whose fickleness few more striking instances are on record. Riches were not at once superadded to fame; and Lee could not either bide the time for their slow accumulation, or resolve to abandon the hope for them, and rest content with the consciousness of having deserved the prize. In the prosecution of this effort of mechanical genius, all his faculties were engaged to their fullest extent, and entire success seems to have been necessary to their continued and vigorous exercise. In proportion as that success was delayed, his horizon darkened and closed in. He could not look with calm and clear vision beyond or above it. He seems at these times neither to have been aided by the philosophy of the schools, which he had studied, nor to have realized the self-sustaining faith of the Christian, which he had for a time preached. The thoughtful mind cannot but revert with anxious and deep sympathy, to the reflections of that once powerful intellect, in the closing hours of life. They have passed away, leaving no record behind. They would, no doubt, be deeply shaded by a sense of the vanity of courtly applause, and of resting hopes of real happiness on anything external to one's self, except it be Divine. The idea must be indulged, that as the services of twenty years before in that small parish church of Calverton would surely often return to memory, so the lonely gloom of that far off chamber might be lighted up by the rays from heaven, which shone upon those early sacred engagements.

Lee should ever be held in high regard by those who study and practise mechanical science, because in the very commencement of modern practical invention, he

asserted its value while he shewed its results; placing his master mind not merely on a level with, but on a higher platform than, that occupied by nobles and even statesmen, who seem never to have disputed the right or withheld the respect due to so eminent a genius.

It has been found impossible to adorn this volume with a copy of the original likeness of Lee. That painting is not to be found. The figure and face of the clergyman in an engraving of the arms of the Frame-Work-Knitters' Company is supposed to be taken from a picture by Balderston, formerly hanging in their Hall, Redcross Street, London. This contained the portrait of a man in collegiate costume, pointing to an iron stocking-frame, and addressing a woman who is knitting with needles by hand. It bore the following inscription:

"In the year 1589, the ingenious William Lee, A.M., of St. John's College, Cambridge, devised this profitable art for stockings, (but, being despised, went to France,) yet of iron to himself, but to us, and others, of gold, in memory of which this is here painted."

As the original painting by Balderston is so interesting a work of art, in connection with this history, it is to be much regretted that Mr. B. Woodcroft is compelled to state that "desiring to place it in the gallery of eminent men in Kensington Museum, he cannot find it, or any likeness of Lee, after enquiries carried on through a long course of years." The following is an extract permitted to be taken from his notice of this eminent inventor, in the "catalogue of portraits in the Museum at South Kensington." Its contents have an important bearing on the possible restoration of the original painting to some worthy public position, having been parted with by the company at a period of pecuniary embarrassment, and probably now in private hands:

"On the inside of the cover of the second book of the company's record, are two lists, dated 1687, of plate, pictures, &c., then belonging to and in the possession of the company; in one of which lists, is an item—'*Mr. Lee's picture by Balderston.*' In 1708, Hatton's book was published, which, at p. 605, vol. II., mentions this picture. From 1732, the company's books shew no more meetings at their hall, which probably the company let, and removed its plate, pictures, &c. to a tavern. There are no minutes of any court being held from 1732 to 1745; from which date the company appears to have held its

courts at the White Hart Tavern, Bishopsgate Street. In 1755, a bond was entered into by the then landlord of the Dog Tavern, Garlick Hill, for securing '*the plate, &c.*,' belonging to the company, and deposited with him for its use; no copy of the bond or its schedule, however, is made in the books. In 1759, the hall was leased to Mr. Seward, a brewer; if not previously, Mr. Lee's picture must then have been removed. In July, 1761, the company removed its 'plate, colors, furniture, &c.' to the Ship Tavern, Threadneedle Street; where the courts were held with tolerable regularity for about nine years; after which various taverns seem to have been used; and subsequently to 1772 the company met frequently at the New England Coffee-House; and again at the White Hart Tavern; but no further mention is made of 'Mr. Lee's picture by Balderston;' which, it is probable, was included either in the 'plate, &c.' of 1775, or 'the plate, colors, furniture, &c.' of 1761; for there is in the company's possession a copper-plate for court-summonses dated 1777, engraved with a similar heading to the above, and as it is not improbable that the picture was in the company's possession in 1761, it is also most probable that the engraving, which tallies with Hatton's description on the plate, dated 1777, was taken from Mr. Lee's picture. There is no entry subsequent to 1770, by which the existence of the picture can be inferred, or its fate determined. The above engraving seems to be a close imitation of the plate dated 1777."

Mr. Woodcroft records an additional statement, derived also from individuals officially connected with the Frame-Work-Knitters' Almshouses in London:

"I can only add, it is my opinion that the picture was, together with others, taken by 'Mr. Robinson of Threadneedle Street,' about 1773, either to wipe off a debt due to him by the company, or as a security for its repayment. Mr. Robinson was an influential member of the court of Frame-Work-Knitters, and resided in Threadneedle Street; courts were sometimes held at his house; and from time to time, he lent the company money, as appears by their books now extant."

In Cunningham's *Handbook of London*, p. 527, this portrait is said to be at Weaver's Hall. R. Seymour, in *Survey of London*, vol. II., p. 603, gives the inscription. Von Uffenbach, in his *Reisen*, vol. II., p. 571, says, "which picture and inscription, I saw."

George Balderston, one of the first wardens of the company under the charter, was probably a relative of the painter of this portrait. If so, he would be likely to take care that the clergyman in the coat of arms, should bear a strong resemblance to the picture.

Is a monument to the memory of William Lee sought after? Let the enquirer visit Nottingham,

Leicester, Chemnitz, Appolda, Troyes, and Nismes. The teeming populations of those cities, with the districts around them, and the vast manufactures in which they are profitably employed, silently and unintentionally, but eloquently, perpetuate his fame. For the foundations of the trade, which has grown into such magnificent proportions and made them rich and great, were laid by him.

CHAPTER V.

STOCKING-WEAVING AND THE CHARTER—1610 TO 1750.

THE writer in *Bibliotheca Topographia Brittanica* already quoted, says "Mr. Lee, after some years residence in France, received an invitation to return to England, and accepted it. Thus the art of frame-work-knitting became famous in this country." This is altogether a mistake. Upon Mr. James Lee's returning from Paris to his countrymen at Rouen, with the sad news of Lee's decease, after a serious conference amongst them, it was decided by seven of the number to return immediately to England, taking with them all the machines except one, which was allotted to the two workmen who remained behind, hoping to get the privileges and rewards promised to Lee. J. Lee brought these frames to London, where they were set up, in Old Street Square, and worked, and became the foundation of the London hosiery manufacture.

Thus was the business very near being permanently established in France from the time of Lee, and in this manner was it, contrary to all reasonable expectation, brought back again. No sooner was the fact of the return generally known, than, as if to make up for the national neglect of the inventor by posthumous appreciation of his genius, people of all kinds and classes strove to become frame-work-knitters. The owners of the returned machines sold them, intending to construct others. This arose from the circumstance that one Aston, then a miller at Thoroton near Nottingham, but formerly an apprentice to Lee before he went to Rouen, though he declined to accompany him thither, had, during the interval, continued to direct his attention to the machine, with a view to its improvement. Immediately, therefore, upon effecting a sale of his machinery, James

Lee left London and returned to Nottinghamshire, and without loss of time joined Aston, who he found had really devised an important addition to the inside parts of the machine. They at once begun to make frames on this plan about the year 1620. The novelty consisted in the introduction of one fixed sinker, placed between every two moveable jack sinkers; and thus, either allowing half the jacks and their sinkers to be dispensed with, or else by the addition of these fixed lead sinkers (so called because their upper ends were imbedded in lead), and an equal number of needles, to double the gauge of the machine. Either way the cost of the frame was much reduced. But, in applying the invention, they found that the jacks must be raised, in the act of lowering the fixed sinkers, in order to get the thread divided into loops of equal depth, without deranging the horizontal line of the needles. They were thus led to discard the lever, working the locker bar from the front, by placing a long lever in front of the locker axles cut aslant in front, and forcing it up by a plate on each side, worked by the thumbs upon an axle at the top, having an inclined nob, and by driving one slant against the other, raised the jacks in front by pressing behind the bar. Thus were the lead sinkers, thumb plates, and lockers added. Machines were built in great numbers, altered in this way, both in London and in the neighbourhood of Thoroton, Calverton, and Woodborough; the population of which villages increased rapidly within the next fifty years, as is evidenced by an incidental remark of Thoroton, complaining, as to Calverton, of the emptiness of the church, notwithstanding the populousness of the parish. William or James Lee had taken an apprentice in London named Mead, whose time was not yet finished, as an apprenticeship might at that period be legally prolonged to the age of twenty-four. The remainder of his term was purchased from James Lee, together with one frame, for £500, by the Venetian Ambassador, who desired to repeat Sully's effort with better success in favour of that city. Venice was still the most commercial city in the world, though the route to India by the Cape was now open. They were reputed to have the best smiths in Europe. The envoy

transferred Mead and the machine to Venice, where it was worked, and others were attempted to be constructed like it, but without success. For, skilful as some of the mechanics were, they could not make needles, or sinkers, or otherwise repair the one in their hands, much less construct others that could be worked. The necessary inside parts would have been continually required to be sent from London, 800 miles overland or 1600 by sea. So when the stock of needles and sinkers was exhausted, the scheme came to an end. Mead, at the close of his engagement, returned to London, bringing the dilapidated machine and the abortive imitations with him, and they were disposed of for little more than the value of old iron. This was in 1621. Zano says:

"That after Mead's unsuccessful attempt, one Gian Battista Carli, a steel worker at Gerona, drew the plan and constructed an imitation of an English stocking-loom, which he had seen at Venice, and established the manufacture at Udino; where frames continued to be worked for some time. But in consequence of the poverty of the Venetians who were employed there in making hose, no more frames were permitted to be set up; and those already at work were afterwards sent to Gradisca, in Austria, where the Venetian Udino hose had been chiefly sold."

Sir Joshua Child mentions that, in 1670, the Venetians had not got the stocking-loom, but that English hose were exported there at that date.

The number of frames and workmen greatly increased both in London, Godalming, and Nottinghamshire; chiefly, however, in London, because of the facility afforded for the execution of orders for fancy goods, made to suit the colour and fashion of the clothes then worn, and which commissions generally required immediate execution.

The London frame-work-knitters formed themselves, early in the 17th century, into a Trade Association; regulating prices, and opposing non-apprenticed hands working at the business. But the employment was so profitable as to induce people to offer money to be taught. Some in the trade took it, and were thought to have committed a heinous offence.

One Abraham Jones, a master stocking-maker in London, was so harassed by this combination, as to go with other transgressors to Amsterdam, taking with him

frames improved after Aston's method. After a time the plague broke out in that city, and Jones, with his wife, family, and all his men, died. His frames were brought back to London about 1633, and were sold for a trifling sum, his adventure being thought unpatriotic, and its conclusion a judgment on him and his.

The rule of the self-constituted company continued to be set at naught, especially in the matter of apprenticeship. Non-apprenticed catholic workers were driven abroad to Brabant, and protestants into Germany, but after awhile most of them returned home again.

The two men left by James Lee in France made little progress; one at length died, and the survivor at the end of forty years still worked his jack-frame, unimproved by the addition of Aston's lead sinkers.

After James Lee's death, the business of stocking-making in Nottinghamshire had passed through Aston and his family into many hands spread over north Nottinghamshire.

In 1641 there were two master hosiers in Nottingham, and it is probable the owners of frames in the north of the county brought their produce to that town for sale to these manufacturers and dealers. From this time the trade gradually spread through the adjoining counties of Derby and Leicester. The midland district, over which it has been located for ages, extends from Chesterfield in the north to Market Harborough in the south, and from Newark in the east, to Ashby-de-la-Zouch in the west, a space of seventy miles by forty-five in its greatest length and breadth.

From the time when the union of frame-work-knitters arose, the London hosiery trade disputes were constant; and the company's difficulties in enforcing their restrictions were becoming every year more pressing. But the manufacture increased at a distance from the metropolis as the result of its freedom, and there was a voluntary transfer of London hands to the counties. James Lee and Aston had long before begun to work on their improved machines, *worsted* (for which they were specially adapted) an article spun in the neighbourhood of Sherwood Forest, from wool grown there of the longest and finest staple in England, and

equal probably to any in Europe. Articles made from this yarn were strong enough to compete in wear with hand-knitted hose, which were made from extra twisted materials.

The London frame-work-knitters now put into their old twelve guages the additional sinkers and needles; and so making them 24 guage; which machines ever since have (with 26 guage) been called *altered* frames.

A master frame-work-knitter, named Pickard, whose family continued in the business so long as it was carried on to any extent in London, determined to teach the art to any one who would pay him, and so set the Company at defiance. He was also accused of making 'fraudulent' *i.e.* underfashioned goods; his silk hose were declared to be unsound, and his worsted hose deficient in the number of threads, and dyed with log-wood instead of madder. Such were the allegations with other more general reasons on which the company rested the application, which, by petition to Oliver Cromwell, they made to be incorporated by charter like other London trades; especially as he had just granted incorporation to the sewing-needle-makers, in 1656.

This application to Cromwell, together with a subsequent similar one to Charles II., were fraught with such important consequences to the trade as to require special notice.

It has not been ascertained where Deering obtained the copy of this petition, which he has given entire in the appendix to his *History*. He has laid his readers under obligation by inserting it. It is a very interesting document, from the insight it gives into the views our ancestors of that day took of manufactures and trade, as well as on account of the manly, though quaint, language in which it is couched. It is also valuable, because of the corroborative facts it embodies, respecting the origin of the business, whose interests the petitioners desired to serve, and of its usefulness and advantage to the commonwealth.

"*To His Highness the Lord Protector of the Commonwealth of England, Scotland, and Ireland.*

"The humble representation of the promoters and inventors of

the art and mystery or trade of frame-work knitting, or making of silk stockings or other work in a frame or engine,—Petitioners to your Highness, that they may be united and incorporated by Charter under the Great Seal of England—Whereby their just right to the invention may be preserved from foreigners, the trade advanced, abuses therein suppressed, the benefit to the Commonwealth by importation and exportation and otherwise, increased; and hundreds of poor families comfortably relieved by their several employments about the same, who will otherwise be exposed to ruin, having no other calling to live of.

"Their trade is properly stiled frame-work-knitting because it is direct and absolute knitwork in the stitches thereof, nothing different therein from the common way of knitting (not much more anciently for public use practised in this nation than this) but only in the number of needles, at an instant working in this more than in the other by an hundred for one; set in an engine or frame composed of above 2000 pieces of smith's, joiner's, and turner's work; after so artificial and exact a manner, that by the judgment of all beholders, it far excels in the ingenuity, curiosity, and subtilty of the invention and contexture, all other frames or instruments of manufacture in use in any known part of the world.

"And for the skill requisite to the use and manage thereof it well deserves (without usurpation as some others impertinently have) the titles of mystery and art, by reason of the great difficulty of learning and length of time necessary to attain a dextrous habit of right true and exquisite workmanship therein, which has preserved it hitherto (from the hands of foreigners) peculiar to the English nation, from whence it has extraction growth and breeding, unto that perfection it hath now arrived at. Not only able to serve your Highnesses dominions with the commodities it mercantably works, but also the neighboring countries round about, where it has gained so good repute that the vent thereof is now more foreign than domestic; and has drawn covetous eyes upon it, to undermine it here, and to transport it beyond the seas. Of whose swifter working to that pernicious end, these petitioners (as most interested) standing in the nearest fent, think themselves in the common duty of well affected persons to your Highness and their country (besides their own case of necessity) bound to make address unto the wisdom protection and care of your Highness (as their predecessors in former times have done to the rulers of this nation) speedily to restrain and suppress all attempts to bring so great a detriment and inconveniency upon the Commonwealth."

"Now so it is, and may it please your Highness, That the trade of frame-work-knitting was never known or practised here in England or any other place in the world before it was (about 50 years past) invented and found out by one William Lea (Lee) of Calverton in the County of Nottingham, gent., who by himself and such of his kindred and countrymen as he took unto him for servants, practised the same, many years, somewhat imperfectly in comparison of the exactness it is sithence brought into, by the endeavours of some of these petitioners. Yet even in the infancy thereof, it gained sufficient estimation of a business of so extraordinary a national profit and advantage, as to be invited over into France, upon allurements of great rewards

privilege and honor; not long before the sudden murder of the late French King Henry IV., unsuccessfully accepted by the said Mr. Lea (at that time wanting due encouragement at home) and transporting himself with nine workmen (his servants) with some friends into Roan (Rouen) there wrought to the great surprise of the French, so that the trade was in all likelihood to have been settled in that country for ever, had not the decease of the late King disappointed Mr. Lea of his expected grant of privilege, and the succeeding troubles of that kingdom delayed his renewed suit to that purpose, into discontentment and death at Paris, leaving his workmen at Roan to provide for themselves, seven of which returned back again into England with their frames, and here practised and improved their trade; under whom (or the master workmen risen under them) most of these petitioners had their breeding and served their apprenticeships. Of the other two which remained in France only one is yet surviving; but so far short of the perfection of his trade (as it is used here) that of him, or what can be done by him or his means, these petitioners are in no apprehension of fear, nor have not been (since then) endangered in foreign countries, by any that have served out their full time of apprenticeship here.

"But near about that time a Venetian ambassador gave £500 for a remnant of time of one Henry Mead, then an apprentice to this trade, and conveyed him with his frame from London to Venice, where although his work and the manner of it were awhile admired, and endeavoured to be imitated, yet as soon as necessity for reparation of his frame and instruments happened, for want of artificers experienced in such work there, and of ability in him to direct them, the work prospered not in his management; so that (his bought time of service having expired) affection to his native country brought him home again to England. After his departure the Venetians grew disheartened, and impatient of making vain trials, they sent his disordered frame, and some of their own imitation to be sold in London at very low valuation.

"And within very few years afterwards the trade was greatly endangered by one Abraham Jones, who having by underhand courses and insinuations (and not by servitude, &c. as an apprentice) gotten both the skilful mystery and practice thereof, did (contrary to the articles, which the rest of the company that had taken some jealous notice of him) pass himself with some more unto Amsterdam, and there taking unto him some Dutch, as servants, erected frames and wrought for the space of two or three years, until the infliction of the plague seized on him and his whole family and carried them all to the grave. His frames also (as things unprofitable to them, that could not find out their right use without an able teacher) were sent to London for sale at light rates.

"These preservations and escapes of this trade from transplantation into foreign countries, these petitioners do with thankfulness acknowledge and ascribe to have been brought to pass by the Divine Providence, limiting his bounties and administration whither he has been pleased to direct them. For it may well seem marvellous in human judgment how otherwise this trade should remain (notwithstanding all the covetous and envious attempts to the contrary practised for the space of forty years past) an art peculiar to only this our nation; and to the nimble spirits of the French, the fertile wits of the Italian, and

the industrious inclination of the Dutch, a concealed mystery unto this day."

The memorial proceeds to state that the manufacture of silk hose raises the value of the raw material six parts in seven, inverting the old proverb, "the stranger buys of the Englishman the case of the goose for a groat and sells him its tail for a shilling;" it may now be said, "the Englishman buys silk of the stranger for twenty marks, and sells it him again for an hundred pounds." Other paragraphs set forth the hands this trade indirectly employs, and assert the greater ability of the English to supply home demand and foreigners with stockings, *calceons*, waistcoats and many other things than they can be supplied elsewhere, and describe it as "an inexhaustible mine of rich and staple commodities wrought by this manufacture for the service of all the great, honourable, and better sort of the inhabitants of the whole commerciable world." They argue finally, that the objection against a machine which so greatly exceeds in its power of production that of knitting by hand, that it would seriously injure public interests by superseding that employment, is unsound, and they cite the case of pin-making by hand superseded by machinery and printing superseding copying by hand for all public and general purposes.

This petition seems to have accompanied a short written one, a copy of which is preserved in the state paper office, and in one part of it the petitioners pray "that His Highness will graciously cast his eye on the printed representation annexed." But there is no trace of any other representation than the above long petition, given entire by Deering, and a copy of which without names or date is in state paper office F. p. 277. At p. 279 is a copy of the order of reference 27th December, 1655, to the committee for trade; p. 281 to 284, is a report of the Lord Mayor and court of aldermen to the committee for trade as to the justice of the claims, &c. and confirming the statements of the petition of 23rd October, 1655; at p. 285 is the report of the committee for trade recommending (and proposing the scheme of) incorporation: this is signed "W. Wheeler," and dated "13th April, 1656.

Down to a very recent date this petition has been generally supposed to have remained unnoticed by Cromwell, and therefore that no charter was granted by him. Deering expresses this view, "For what reason I cannot tell they did not obtain it at that time." Blackner says Cromwell did not refuse; but Gardner, *Music and Friends* in 1835, says expressly that Cromwell granted them a charter. In this he stated the real fact. On this point the result of the researches of Mr. Woodcroft, made a few years ago, leaves no doubt. A copy of the letters patent of Oliver Cromwell, dated 13th June, 1657, incorporating the company of frame-work-knitters, and the act of the common council in that year regulating the binding of apprentices to members of that company passed in the same year 1657, were found deposited in the office of the town clerk of London. The charter contains the words "it being an English invention." It was enrolled in the city archives 13th July, 1657. Its tenor was referred to in a further petition dated 3rd December, 1658, from the frame-work-knitters of London, which asked for measures to prevent the export of frames. It was accompanied by an affidavit of two citizens, "that thirty to forty frames were about to be exported." An order in council was granted 14th June, 1659, forbidding the exportation of any frames and engines for knit-workers of silk stockings, and a third petition prayed for frames seized to be brought into the custom-house, London. The last has no date.

During the short interval which elapsed after the grant of the letters patent by the Protector, and the accession of Charles II., when all his acts were set aside, the company now established legally does not seem to have exercised any authority over the trade calling for notice; 400 out of the 650 frames then in England (a good many having been exported) were in London, chiefly in St. Luke's, Norton Folgate, and Shoreditch, of which three-fifths were employed on silk work, stockings, waistcoat-pieces in colours, trowser-pieces, striped and of stout ingrain dyed materials. Frames as yet had no sleys to steady the jacks, nor caster backs, but in 1670, Needham, a workman in London, placed two additional trucks on the sole bar. The needles had

before been soldered into brass, but were now cast in lead; the combs were formerly wedged in with counters and were very broad, the jacks long and heavy, and they still used treddles to move the sinkers: these were now all improved. In 1711 the caster back and hanging-bits were added by Hardy, also a London frame-work-knitter. Since then no improvements of the power or speed of the machine have been effected until the present century.

After Cromwell's death, the company lost no time in applying for a new charter, and obtained it. An abstract of the frame-work-knitters' charter, then granted, will shew the powers on which they acted for the next hundred years: it is from G. Henson's unfinished *History of the Trade*, p. 79:—

"1. I, Charles (2d.), by the Grace of God, &c. having taken into consideration the petition of the frame-work-knitters of London, Westminster, England, and Wales, seeing that many deceits and abuses are made, to the ruin of their families by strangers and others, think it necessary to uphold the trade, for the general benefit of my subjects, as well as the frame-work-knitters, and as the frame-work-knitters are dispersed among other trade companies in London, and have not proper government for the management of their own.

"2. Being desirous of encouraging the manufacture, all persons having served seven years apprenticeship, and apprentices who shall hereafter serve seven years, and all others who may be admitted as follows, shall be one fellowship and body corporate and politic, by the name of master, wardens, assistants and society of the art and mystery of Frame-Work-Knitters of the kingdom of England and dominion of Wales; and shall have power to govern the said trade in the said kingdom, as herein directed; and they shall have in that name perpetual succession.

"3. The society shall have full right in that name to hold any property not exceeding £100 yearly.

"4. And shall have power in that name to sue and be sued at law.

"5. The said society shall have a common seal, which they may alter at their pleasure.

"6. The society or company shall consist of one master, two wardens, and fifteen or more assistants.

"7. John Croson shall be the first master, and shall continue in office until the Nativity of St. John the Baptist (24 June) 1664, upon taking the oath before a Master in Chancery, and the master shall be chosen annually from the two wardens.

"8. Jonathan Gramer and George Balderston shall be the first wardens; who shall continue in office till St. John's day, when the wardens shall be chosen annually from the assistants.

"9. John Lee, Thomas Phillips, Joseph Tomlinson, Richard Read, William Rigson, William Gramer, Gabriel Brewer, Samuel Knight, Francis East, J. Pagiter, jun., Samuel Tomon, Owen Lavender, John

Bennett, jun., F. Armstead, Thos. Stevenson, George Massie, Osmond Smith, Wm. Pickerne, and Thomas Ladd, to be assistants for life.

"10. The wardens and assistants shall choose a master on the feast day of St. John the Baptist in room of John Croson, who shall continue one year.

"11. The master, wardens, and assistants shall choose two wardens at the same feast to continue in office one year, but shall remain assistants when out of office.

"12. The master or wardens dying, there shall be a new election within fifteen days.

"13. Upon the death of an assistant, the master, wardens, and assistants shall supply the vacancy from the society.

"14. Any person of the society who shall be so nominated and refuse to serve shall be fined any sum not exceeding ten pounds, to be enforced by distress and sale of his goods.

"15. The society shall appoint a clerk of the company.

"16. John Hennis, gent., shall be clerk for life, all other clerks after his decease may be removed at the pleasure of the company.

"17. The master, wardens, and assistants, may make such laws and regulations as they think proper, for the government of the society, for the reformation of abuses, or preventing fraudulent work; and may inflict and levy fines by distress and sale or otherwise.

"18. Such laws, ordinances, &c. not to be repugnant to the laws of the realm, nor prejudicial to the customs of the City of London.

"19. The master, wardens, and assistants, shall choose a beadle; but Wm. Patrick shall be the first beadle, to serve only during pleasure, under the seal of the company; and shall have power to levy all fines by distress or otherwise.

"20. All mayors, sheriffs, bailiffs, constables, and officers, are commanded to assist the company according to the laws of the realm.

"21. The master, wardens, and assistants, shall from time to time, appoint two deputies from the society, under their common seal, to search in the day time, in the presence of a constable, any place, whether privileged or not, to try and prove whether all stockings or frame-work-knitted goods, be workmen-like wrought, and if found badly made, or of deceitful stuff, to cut the same in pieces; and to fine the parties making them, according to the bye-laws of the company.

"22. The master and wardens shall administer an oath to the deputies, that they will rightfully and faithfully perform their office as searchers.

"23. Such deputies shall be chosen yearly or oftener; and may be removed on just cause.

"24. The invention being purely English (natural born subjects as well as aliens, having by secret means endeavoured to take the art to foreign states, to the discouraging of the industrious subjects) no person, whether freeman or foreigner, denizen or alien, shall presume to carry or cause to be carried, any frames used for making silk stockings, or used in frame-work-knitting, beyond the seas, upon any pretence whatever.

"25. The master, warden, assistants or deputies, or any two of them, may seize such frames going to be exported, and may deposit the

same in the custody of a lawful officer, until due proof be made thereof before a justice of the peace, when it shall be forfeited; such conviction and judgment shall be within forty days, if within twenty miles from London; and six months, if further distant.

"26. One half the value of such forfeiture shall go to the company, the other to the exchequer.

"27. The master, wardens, &c. may search for fraudulent frames, fraudulent machines, and fraudulent goods.

"28. No person shall follow or use the trade of frame-work-knitting, unless they shall have served seven years apprenticeship, according to the custom of London.

"29. Every person using the art of frame-work-knitting within twenty miles of London, must enter the society in three months; and beyond twenty miles in six months; and take the necessary oaths, or forfeit £5 for every week they may neglect.

"30. Persons who are freemen of the City of London, or of any other company, are commanded to bind their children who are frame-work-knitters, to the members of the frame-work-knitters' company.

"31. The Lord Mayor of London is commanded to enrol this charter in the records of the common chamber of London, that they may become freemen.

"32. The master, wardens, and assistants may receive any person they think fit, upon taking the oaths, into their body.

"33. The master shall enforce the statute of the 5th Elizabeth, or any other statute as respects apprentices, and the occupations of the trade.

"34. The master, wardens, and assistants may appoint deputies in the districts where the manufacture is carried on, who shall have the same powers in their districts, as to the enforcing the bye-laws and statutes.

"35. Such deputies shall report under their hand and seal, an account of all their transactions as to money, &c. from time to time, to the company, and must render an account and pay the money yearly.

"36. The society shall pay yearly to the Exchequer four nobles, on the feast of our Lord God (25th December); and if not paid in forty days, shall forfeit 20*s*.

"37. All justices, custom-house officers, &c. are required to assist the company.

"38. This charter shall be taken in all courts of record, and construed most largely.

"39. The master, wardens, &c. must take the oath of allegiance.

"40. If the master, wardens, and assistants do not enrol this said charter before the clerk of the peace within six months, they shall forfeit £10, and so for every six month's default.

"By the King,
"HOWARD.
"Fine twenty marks.

"Signed 19th August (1663)
"in the 15th year of the King."

The body of frame-work-knitters never cordially acquiesced in the provisions of this charter. Nor was this at all surprising. Here twenty-four persons caused

themselves to be appointed for life, with power to name their successors; to make laws and enforce them by fines; to levy fees, and to dispose of fines and fees at their pleasure. And which was the most objectionable clause of all—causing in the end the limitation of their authority and influence within the narrow bounds of a London nominal hosiery trade company—they were empowered to choose their members from the body of citizens, whether frame-work-knitters or not. A corporation so composed, could neither sympathise duly with, nor long exercise authority over bodies of workmen dwelling in distant parts of the kingdom.

An adverse feeling to the company shewed itself in London, and still more in the country. The disputes continued as to the number of apprentices that might be taken. The Act, 5th of Elizabeth, was construed by country masters and magistrates not to include frame-work-knitters as weavers. The number of frames had increased in London, in 1695, to 1500: notwithstanding many having been sent over to Ireland, to which country the charter did not extend; and was, therefore, resorted to by those stocking-makers who were anxious to employ an unlimited number of apprentices. But Tyrconnel, the viceroy under James II., granted, in 1686-7, a charter embodying larger powers than the English one. The application for this was made at the instance of the London company, in order to strengthen their own position.

More than 400 frames had also been exported between 1670 and 1695, in spite of the company's efforts; amongst other places, to Paris, Orleans, Rennes, and Caen; Louvain, Tournay, and Valenciennes; Cordova, Seville, and Cadiz; Rome and Messina. The 7th and 8th of William III. fined persons £10 for removing frames without notice. All were ordered to be numbered; and if missing, or unaccounted for, the parties were exchequered. This legislation immediately caused the practice of exporting frames to cease.

The low price of admission to the freedom of the company, and its indiscriminate character, letting in persons merely desirous of the municipal and parliamentary vote, or of obtaining a position in the Guild,

produced in the first forty years of the operation of the charter, a marked change in the members constituting the Hall. The income was large from registration of apprentices, enrolling freemen, fines levied, and premiums on the sale of freedoms and livery. So, as they could hold only £100 a year, the company fell into expensive pomp and pageantries. A carriage for the master, gold lace liveries for beadles and attendants, a gilded barge, a large band of musicians, flags emblazoned with their arms, and finally, a new Hall erected in Redcross Street, in which to hold their courts and feast sumptuously, absorbed more than their income, and in time brought the company into debt. The fees levied to support this expenditure were enormous; and had the effect of rapidly increasing the business in the midland district, by sending the trade thither.

Of the frames built in Queen Anne's reign the principal parts of many still exist. They attest that the smiths had then arrived at great excellence in their art. Worsted hose were made of three, four, and five thread yarn, and in turned shapes, narrowed clocks and fancies. They produced also worsted breeches-pieces, and webs for waistcoats of varied colours and stripes. Gore clocks were silk hose with heels six or seven inches long; and by which the instep was made an inch narrower than in plain. The labour in making them was much increased; as also in making turned shapes and parti-coloured hose; all which kinds were for a long time fashionable. Very heavy plain and embroidered silk hose were much worn. The workmen gained on plain, 2*s.* 6*d.* to 3*s.* 6*d.* a day; and on embroidered, 3*s.* 6*d.* to 5*s.* a day. The average of the hands only worked about four days a week, as meat was 1½*d.* per pound, and bread 14*d.* a stone. The earnings throughout the trade were computed to average 10*s.* a week in the country, and 15*s.* in London. The number of frames in 1727 was 2,500 in the metropolis, and 5,500 in the provinces. In consequence of the expensive wars in Anne's reign, trade became inactive, and many stocking-makers were, for a time, unemployed. This season of privation naturally caused the journeymen, as well as the masters who adhered to the company's

bye-law of taking not more than three apprentices to one journeyman, to turn their attention to the unlimited number of apprentices now taken—ten or more to one journeyman. The company, upon an application made to them about 1710 to repress this practice, had declined to act; on which occasion, one Nicholson's frames were broken in London. The circumstance will be noticed when Luddist feats are subsequently described. One of the apprentices of that epoch, Hardy, was not only the inventor of the 'caster back' and 'hanging bit' during his apprenticeship, but was the first workman who "met the presser and passed over the arch at the same time." This he did while under age.

Upon this destruction of machines, two masters who infringed, Cartwright and Fellows, took their frames away from London to Nottingham; the former having twenty-three, and the latter forty-nine apprentices.

It was resolved at a general court of the company, held on the 7th of June, 1720, that as the renter warden had at that time £10,000 in his hands; and as it was expedient to remedy the evils arising from underselling of goods made by non-apprenticed hands in the country, a company should be formed to carry on the trade and defy all competition. A capital of two millions sterling was to be raised, in shares of £1000 to £10,000 from each subscriber, 25*s.* to be paid for each £1000 to reimburse charges. "Each of the eighteen assistants was to have his name put down for £1000, for which he was to pay nothing." Shortly after, they resolved that "all the undivided stock should be divided amongst the projectors without their paying deposits; and for which stock they should have receipts given in such names as they should nominate." Of the first £1800 received for shares, Pocklington, who projected the scheme, received two hundred guineas "for his invention and trouble," and warden Austin ten guineas "for his extraordinary trouble." Cash was advanced for goods received from any assistant. The seal of the company was affixed to these proceedings, by which, stocks in the hands of the members of the company were so much lightened, that wages rose in London, and at Godalming, Oldham, &c. For a time

bonds for £1000, on which £12. 10*s*. had been paid, sold for £15. 15*s*. Before long the question of legality was raised; and counsel advised that the chartered company required an Act of Parliament to enable them to trade as a Joint Stock Company. They nevertheless continued to do so for ten years. In 1730 the making of goods was discontinued by them. The accounts were audited, and the affair was ended by resolving "that the two million joint stock fund was attempted to be raised for the good of the chartered company, and that the balance remaining in the hands of the prime warden should, in future, belong to the company."

The £10,000 fund was expended in this manufacturing scheme, and the company became so impoverished, as to be obliged to borrow even the small sum of £50 on bond. Several such transactions are on record, as having occurred during the next half century, in some of which the plate and pictures of the society were transferred, at least for a time, as security.

To replenish their funds was no doubt a very pressing motive for the desire manifested to establish more firmly the power of the company in the country, and for this end, to put in force a duly authorised code of bye-laws.

Another important consideration impelled them to activity. The Chartered Company had for some time perceived that the trade had declined in London, and in consequence had held quarterly courts by their deputies; visiting Nottingham and other places for the purpose of admitting apprentices, levying fines, and admitting to the freedom of the company. At Nottingham, this court sat at the Feathers tavern; and at this time was instructed to put into strict operation the bye-laws and authority of the company; so as to put a stop to this tendency of the business to emigrate from London, if possible, and at all events, keep up the income of the company. The deputies therefore proceeded to levy a fine of £400 on Fellows, and one of £150 on Cartwright. These persons refused to pay any fines, when, as authorised by their bye-laws, their goods and frames were sold by the deputies and beadles of the company.

The justices and gentry generally of the midland

district had observed with disquietude, that the intention was to effect a two-fold and serious evil; to prevent the growth of the country manufacture, and so far as possible restore and confine it to London; and further, to withdraw a very large annual income from these parts. They very unwillingly convicted on these complaints, and were well satisfied when an action was brought for trespass by Cartwright, against the officers of the company, which was tried at Nottingham in 1728. It was then found, that the bye-laws had not received the assent of the chancellor or judges; as, to prevent the abuse by chartered corporations and companies of their powers, their bye-laws were required to be, by the 19th Henry VII. It was moreover urged, that the charter gave the company a legislative power, inconsistent with the constitution. The company said they acted on the 5th Elizabeth. To this it was replied, that frame-work-knitters were neither 'cloth workers,' nor 'weavers.' It was then contended that they were 'hosiers,' which brought them within the statute. To this it was rejoined, that frame-work-knitting was not a trade at the time of passing the 5th Elizabeth. After a long trial, a verdict was given for Cartwright. The effect of this trial was, for a time, to render the operations of the company nugatory outside of the twenty miles round London, and practically to restrict it to the city.

All power of interfering with the operations of the county masters being withdrawn, the number of apprentices became larger than ever. As an instance of the temptation to excess, by parishes offering £5 with each thus taken off their hands, and the under prices at which their work was performed; one man having a shop of frames in Brewhouse-yard, just outside the Borough jurisdiction of Nottingham, always had a staff of twenty-five apprentices, more or less, and never employed a journeyman for more than thirty years.

Another cause for an increase of the business in the country, at the expense of London stocking-makers, was a change in fashion. Gay colours and fancy patterns were gradually disused, and the merchants and hosiers in London began to find that they could obtain good

work at less prices in the country. Therefore they sent their orders for plain articles, more and more to Leicester and Nottingham; so that by 1750, there had been a diminution of frames in London to 1000, and in Surrey to 350; 800 having been sent down to Nottingham, and nearly as many to Leicester, and sold at a low price. The number in the former place had become 1500, 1000 in Leicester, and in Derby 200; elsewhere in the midland counties 7300; in other English and Scotch towns 1850, and in Ireland 800; total, 14,000.

It is to be remarked, that the first pair of cotton hose from yarn spun in India, four threads being used for the legs, and five for the heels, had been made in 1730 from a 20-gauge silk-frame in Nottingham. At first, the yarn spun from cotton wool was not of suitable quality for use in the hosiery frame; it was harsh, and two highly twisted to bend easily in forming loops. In proportion as its use grew to be important, from the greater magnitude of this trade, efforts were put forth with success, to make the exact article required.

The company shewed occasional signs of animation, by endeavouring to retain and exercise control over the operations of the country master stockingers. In 1734, they tried to enforce their claims to authority, and threatened legal proceedings; but the known invalidity of their bye-laws strengthened resistance, and deterred the company, for the present, from further attempts to sustain them; but decided them rather to construct carefully a new code, and to obtain for it the proper legal sanction.

They carried out this determination; and in 1745, the company made a new set of bye-laws, to which the signature of the chancellor was obtained; but which, in 1753, had the effect of entirely upsetting their authority to regulate the trade. They were as follows, viz.:

"1. The court of assistants shall yearly, on Midsummer day, choose out of the assistants, one master and two wardens.

"2. And at the same time choose three persons to audit the master and wardens' accounts.

"3. And may choose others to fill the office of master and wardens on their dying or being displaced within the year.

"4. The master and wardens shall, within one week, be sworn into their offices.

"5. The court shall as often as they think fit, admit such members as are free of the city and of the livery, to be assistants; upon refusing to serve, to forfeit £10.

"6. And may admit into the livery, so many of the members of the company as they may think fit, and every person so admitted refusing to come into the clothing (unless shewing reasonable excuse before the Lord Mayor or one of the aldermen) to forfeit £20.

"7. The court may elect two or more members to be their deputies, to rule and govern all persons exercising the trade of frame-work-knitting, according to the powers of the charter, within such district as may be assigned them apart from their habitations.

"8. The court may elect yearly, on the second Tuesday in April, two members as stewards, within forty miles of London, who shall provide a dinner on Midsummer day, for the master, wardens, and assistants, at their own charge, or forfeit £6; such dinner not to exceed the value of £12.

"9. The court may elect three members to be stewards, on Lord Mayor's day, who shall provide a dinner of the value of £21, according to a bill of fare to be presented to them, or shall pay their share of £7, or be fined £10. No person to be chosen steward who has served the office before.

"10. The court may choose a clerk.

"11. The court may choose a person, being a member, to be their clerk.

"12. The company shall have a chest with three locks for the custody of their treasure; the keys of which shall be kept by the master and two wardens.

"13. Four quarterly courts shall be held every year, for every member that will attend, to hear the ordinances read. The court of assistants shall attend, as often as required by the master and wardens, to transact the business of the company. Every member neglecting to appear, to forfeit for the first offence 1*s*., the second 2*s*., and for every other default 5*s*.

"14. It shall be lawful for the master and wardens, or any two of them, with two or more assistants, and also for their sworn deputies, four times in every year or oftener, in the presence of a constable, to enter into shops, &c. to view, search, and prove all frame-work-knitted goods, *frames*, &c.; and if found defective, to seize the same, and produce them at their hall of meeting on their next court day; to be fined at the discretion of the court, not exceeding 10*s*. Every person obstructing the master, &c. to be fined £5. The master on searching any house may demand 4*d*.; any person refusing to pay, to forfeit 3*s*. 4*d*.

"15. No member to hire frames, but of such as are members, on pain of paying 1*s*. per week for every frame.

"16. No member shall teach and instruct any person in the art of frame-work-knitting, other than his male child, or children, or apprentices, unless bound according to the ordinances of the company, upon forfeiture of £50 for every offence.

"17. No member shall retain an apprentice until, for trial of his skill, he shall have wrought in the presence of the master and wardens,

or some persons appointed by them, a pair of silk stockings, and upon finishing thereof, if approved, he shall be allowed as a work-house keeper, upon pain of forfeiting £5.

"18. No person shall exercise the trade of frame-work-knitting, unless he shall have served seven years' apprenticeship, and shall first be admitted a member of the company; and neglecting to be a member for three months, to forfeit 30*s*. for every neglect.

"19. No person shall employ an alien or foreigner, under penalty of £10 for every offence.

"20. Every member residing within forty miles of London, who shall be minded to take an apprentice, shall present him within one month at the hall; or, if at a greater distance, to the deputies, to be bound by the clerk of the company, on pain of forfeiting 40*s*. Any member, free of the City of London, who shall cause an intended apprentice to be bound to a freeman of any other company, shall forfeit £5.

"21. No member shall turn over his apprentice, without license of the master and wardens, on pain of forfeiting 40*s*. for every offence.

"22. No journeyman shall depart his service, without a month's warning, except for non-payment of wages, or by mutual agreement; and no master shall turn away such journeyman, without the like warning, and paying him what shall be due to him, under a penalty of £5.

"23. No journeyman shall work with any, but such as are members of the company, under a penalty of 20*s*.

"24. No master shall set any person on work but such as are members, except his male children or apprentices, under a penalty of £5.

"25. The master and wardens within forty days after quitting office, to bring in their accounts to the auditors.

"26. The master and wardens, or any person appointed by them, shall receive of every member using the trade as a master, 6*d*. per quarter; and from every journeyman 3*d*. per quarter. Every member refusing to pay the same when demanded, to forfeit 6*s*. 8*d*.

"27. Every member shall contribute proportionably to the necessary expences of the company, upon pain of paying double what he shall be rated at for that purpose.

"28. Every member free of the City of London, who shall neglect to enrol his apprentice before the chamberlain, within one year after the binding, shall pay 20*s*.

"29. Widows, on being admitted members, may exercise the trade during widowhood.

"30. The court of assistants may moderate, or wholly remit, any penalties, provided such persons pay such sum, without suit at law.

"31. All fines and penalties to be sued for in the name of the company, by action of debt, in any of His Majesty's Courts of Record.

"The following are fees paid to the company:

"Admittance 10*s*., clerk 2*s*., beadle 1*s*., stamp 2*s*., total 15*s*.

"Apprentice bound 3*s*., stamp 3*s*., clerk 2*s*., beadle 1*s*., total 9*s*.

"Work-house keeper's proof piece 3*s*., clerk 2*s*., beadle 1*s*., total 6*s*.

"Apprentice turned over, 3*s*. 6*d*."

The new bye-laws being duly legalized, the wardens, clerk, a full court of assistants, and beadle, came to Nottingham, and placed them before a large meeting which they had convened of the trade. After much discussion, a determination was come to, not to submit to them by the masters, and by the court to enforce them by law.

Petitions were in consequence sent to parliament from several parts, complaining of the arbitrary nature of these regulations. That from Nottingham complained:

"That certain of them were against all reason, and contrary to the general liberty of the subject, by the company levying taxes, to assist them in extending their jurisdiction all over the kingdom, with power to search premises of the frame-work-knitters; monopolizing the lending of frames for hire; and thus prejudicially affecting and oppressing the trade."

The petition from Godalming added:

"That if submitted to, the result would be, the decay of the manufacture, and to bring greater burdens on parishes."

These petitions contained the first direct reference to the practice now beginning, of letting out frames for hire, by owners of them not in the trade, and on which the fifteenth bye-law has a pointed bearing. This charge on the men was strenuously resisted for years afterwards, on the ground which has been taken ever since by its opponents, that it encouraged persons out of the trade to purchase frames, or cause them to be built, not because they were needed for the requisite supply of goods, but solely for the income to be derived from them as rent; and thus, by inevitable competition, overload the business with both machinery and hands to work it.

In connection with the extraordinary influx of apprentices into the business, another practice was introduced about this time which, by the mode in which it was carried into effect, has had a most pernicious influence on the character of a large part of the work-people, and as a necessary consequence, upon that of the trade. The apprentice was allowed so long a time to learn to work the stocking-frame, usually three to six months. As he grew in age, and required more sustenance, he had a certain stint, so many pairs of hose to make as his week's work, and all he earned beyond

was his own. This in itself was just and wise, both to himself a stimulus, and a remuneration for his board, &c. to his master. But he has for ages been allowed to work it very much when, and as he pleased, and he became too often the "shacking lounging stockinger."

To return. In consequence of the rigour with which the company did enforce them, the bye-laws being petitioned against, were referred with counter-petition of the company, to a select committee of the house of commons, who having possessed themselves of the books and papers of the company, and heard the complaints of the petitioners and other evidence, as also the replies of the company and their supporters, in defence of their proceedings, resolved, on the 13th of April, 1753, to report as follows:

"1st. That it is the opinion of this Committee, that the several persons employed in frame-work-knitting in the town of Nottingham, who have petitioned against the Company of Frame-Work-Knitters, have fully proved the allegations of their petition.

"2nd. That the petitioners from Surrey have fully proved the allegations in their petition.

"3rd. That it is the opinion of this Committee, that the bye-laws of the Company of Frame-Work-Knitters, incorporated by a charter, bearing date 19th August in the 15th year of the reign of Charles II., are injurious and vexatious to the manufacturers, and tend to the discouragement of industry, and to the decay of the said manufacture.

"4th. That it is the opinion of this Committee, that many of the said bye-laws are illegal, and contrary to the liberty of the subject.

"5th. That it is the opinion of this Committee, that the powers granted by the said charter are hurtful to the trade, and tend to a monopoly.

"6th. That it is the opinion of this Committee, that the carrying on vexatious prosecutions against any person, male or female, for exercising the art and mystery of frame-work-knitting, is hurtful to the manufacturer, and destructive to the trade of the kingdom."

On 19th April, 1753, a committee of the whole house agreed to the third resolution against the bye-laws, as injurious and vexatious to manufacturers, and discouraging industry and trade. The consideration of the fourth was postponed, and the fifth and sixth were agreed to and confirmed by the house. The effect of this vote of the house of commons was to deprive the company of all hope of legally enforcing their authority. They therefore abandoned the suits they had commenced,

and from this time ceased to exercise any real authority over the trade at large, merely existing as a London chartered body.

Throughout all these proceedings, legal and parliamentary, the masters and country gentlemen opposed, while the journeymen supported the company.

Trade corporations were for many ages very useful in fostering manufactures, and securing to those who embarked skill and capital in them, their due reward. They also by combining in large masses the otherwise powerless individuals employed in each kind of labour, gave to such bodies the opportunity for offering a united, and therefore strong expression of opinion, and of presenting to feudal power and despotic governments, a bold front on any question affecting the rights or interests of the manufacturer or the citizen. In these respects they had their useful sphere of operation, becoming as it were standing chambers of commerce. But they did not in process of time confine themselves to this. The natural tendency of exclusive privilege was to inert monopoly and confined efforts. They were as jealous of innovation in their method of manufacture, as of the intrusion of unauthorized labour. Prices for work and goods were maintained at an unnatural height, that heavy imposts might be laid on initiated members, to be expended on extravagance and shew. While, except under permission difficult to be obtained, a non-apprenticed person, one not regularly brought up to the trade, let his genius be ever so brilliant or his discoveries ever so important, might not practice his invention in it. Ingenious foreign inventors would naturally be subjected to still greater difficulties unless introduced under powerful counter protection.

One of the strongest arguments that has been brought forward at various times for the revived exercise of power to regulate the manufacture of hosiery under the privileges granted by this charter, as in 1778 and again in 1849, is that it would enable an effective guard to be maintained against spurious quality, whether in materials or work. But experience shews that almost the only laws which can be practically executed in trade are those directed against positive fraud. Even the rights of the

true inventor are difficult to ascertain, and often too expensive to be enforced. All restrictions, internal or external, upon the freedom of action in trade, must be very limited and exceptional in their operation to be beneficial or safe.

At this epoch, 1740 to 1750, the wages for making the common kinds of worsted hose were reduced very low; and many of the parish apprentices, ill managed, ill taught, and little cared for, were reduced almost to starvation. Idle and dissipated habits were the consequence, and became the precursors of general depreciation in the clothing and dwellings of the country frame-work-knitters. It is related "that there was often only one coat in a shop, which was worn by each in turn as he went out from its precincts; so that one Moss, a Northamptonshire master, refused to employ a man possessed of a good coat, declaring the best workmen were only to be found in ragged ones." This was quickly followed by the production of inferior goods; and to such an extent had the quality and use of English silk goods declined, and those made in France been imported, that Parliament in 1754 prohibited their introduction, avowedly because the balance of trade against us was become so large. For twenty years English workmen put 'Paris' in the welts, that they might pass in sale for French.

The national rivalry was at length stirred up to such a point on this head, that frames of finer guages were constructed; and specially to meet in a proposed friendly contest between the two countries, a 38-guage silk-frame was constructed; one Joseph Stocks, the best workman in the English trade, being appointed to work it. Frequent examinations and consultations were held, that it might be kept in good working order. But, in the end, the London referees decided in favour of the French wrought hose.

The Spaniards had made gloves at Cordova from the stocking-frame; also mitts were now first made there, and in these articles the English imitated them. The fingers were all made with extra inlaid threads, and had perfect selvages. The thumbs and gussets were formed separately. These articles were ornamented on the backs,

and had eyelet-hole open-work fingers, produced by removing stitches from one needle to another. Rose leaves and other fancy objects were introduced of such elaborate workmanship, that journeymen were often paid 5*s.* or 6*s.* a pair for making them. And some workmen could make two pairs in a day.

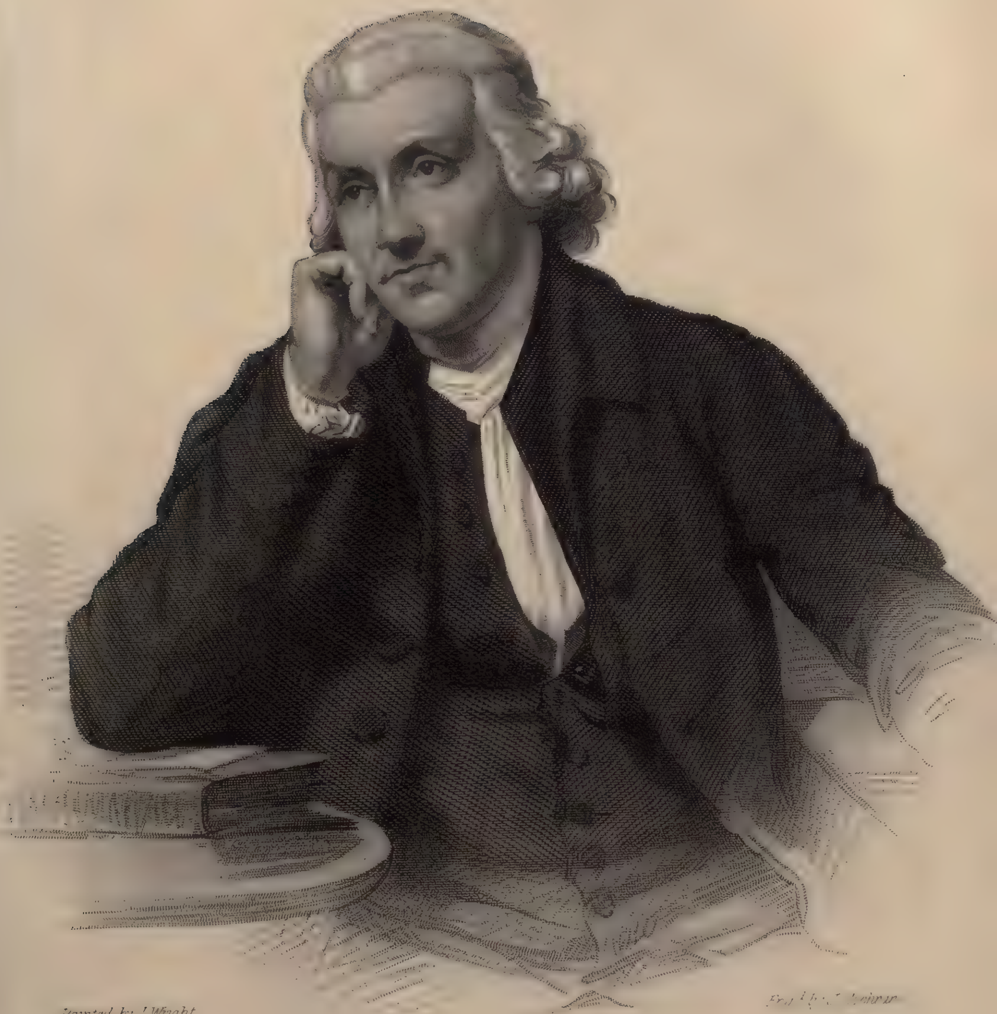
In 1750, there were fifty manufacturers, employers of 1200 frames, called 'putters out,' in Nottingham, all trading directly with London; 1800 frames were also thus employed in Leicestershire on woollen hose.

CHAPTER VI.

THE DERBY RIB HOSIERY-FRAME. MR. JEDEDIAH STRUTT.

The manufactures of this country were still carried on in the middle of the last century at the homes of the work people usually, and in general on a very limited scale. Though the mercantile marine of England had been gradually extending its visits to distant shores from the time of Elizabeth, and returning with supplies of the products of foreign fields and looms and mines, yet in the main the demand for them was found amongst the upper and middle ranks of society. Very small stocks of wrought articles were kept any where except in cities and towns of note. The bulk of society relied for the supply of necessaries and even of things convenient upon the labour of their own hands in their various crafts, and so getting what they needed by interchange with their neighbours. Travelling even in the busiest parts of England was still slow, along difficult roads, and often not safe ones; therefore internal commerce was as yet advanced but little beyond its infancy.

Whether from the political freedom and security enjoyed during the previous half-century, which always stimulate where they are present the industry of those who by their benign influence enjoy a larger proportion of the results of their labours; or whether from the greater expansion of mind and the direction of its powers to useful purposes amongst the middle classes, arising from the study of the literature of the previous century, added to more extended intercourse with the continent of Europe, there was an undoubted movement upwards in society. Many most important changes were about to be introduced and discoveries and inventions made known, which however accidental some might seem, and none of them perhaps directly traceable to any general



Painted by J. Wright

Jed: Strutt

cause, yet could not but have resulted from vigorous thought and well conceived design—themselves the symptoms of an improving age.

Thus new sources of supply of cotton wool, then only recently introduced into our raw materials for clothing, were opened up, and improved methods were adopted in the growth of sheep's wool. New machinery to spin both was at hand. The more general substitution of coal for wood as fuel soon followed. Fresh vigour with improved scientific resources were applied to our mines. Well formed roads managed by local turnpike trusts and canals excavated in every direction, gave new means of ready transit for materials and goods, while stage coaches and mails offered greater facilities for personal communication. When completed by the addition of steam, since become an all pervading agent in aid of labour, the last half century may be truly said to have magnificently inaugurated a new manufacturing system, which has issued in the enlarged capital, commerce, and enjoyment of the people generally.

Symptoms of desire to emerge from the small scale on which all productions beyond those necessary for food were cultivated, and the homely manner in which manufactured articles were wrought and enjoyed, were early manifested in the midland district, and on its northern borders in Lancashire and Yorkshire, where at that time the manufactures of cotton and woollen cloth were even more rudely carried on than that of hosiery in the counties of Leicester, Derby, and Nottingham, and not to a much greater extent. Indeed the latter town co-operated in some important degree in the early arrangements, which issued in the greatest of our textile manufactures—the cotton trade.

This state of things was an introduction to that long train of ingenious efforts which begun now to be made, in order primarily to improve the demand for hosiery, by modifications in the methods and kinds of its productions. The local developement of inventive skill had some relation, there can be little doubt, to the spirit of enterprize rising into activity all around. Here as elsewhere it was without pretension in the beginning, but very marvellous and unlooked for

in its results. The alterations and new constructions in hosiery and lace machinery had become before 1815 so numerous and intricate that Blackner, in his *History*, altogether declined the description of the then later important ones. Fifteen years after, Henson expressed his sense of the difficulty there is in giving numerous mechanical details, so as to be clear without becoming wearisome. Since his publication the duty has become doubly onerous. But the endeavour to compress will, it is hoped, be now so performed as to give the object of each new plan, and the mode of its accomplishment where necessary, with sufficient clearness, yet without drawing too largely upon the patience of the reader.

The first step in this course will be to describe the modification in the use of Lee's frame by the 'tuck-presser,' and the subsequent independent addition to it of Strutt's Derby ribbing machine.

No attempt, so far as is known from any existing record, had been made to add any machinery to the stocking-frame for the purpose of varying the face or appearance of the web it produced, until the earlier part of the eighteenth century. About the year 1740, an apparatus was applied to it for the production of a kind of fancy work in hose. By some this was said to be a French invention, alleging it to have been practised by Paris workmen under the direct inspection of Louis XIV., who they affirmed took great pleasure in the operations of the stocking-frame, and even knew how to work in it. But though not impossible, there does not seem to be any proof of this. Nor is it more certain that it was invented, as others said, in Dublin; though brought by an Irishman to Nottingham between 1740 and 1756. This addition to the stocking-frame was called a 'tuck presser.' A 'tuck' is the technical name for two or three loops accumulated on the same needle, in the process of making as many courses of loops by these not having passed regularly over the heads of the needles. To make such loops in regular lines or ribs down the hose, or in zigzag lozenges and other forms required, a second presser was needful to act in place of the ordinary one at the necessary intervals of courses, and on particular needles.

This tuck presser was a thin bar of iron attached to the frame presser, but so as to admit of its moving sideways to and fro, the space of one or more needles. Grooves were cut in its lower edge to admit the beards of needles under the grooves not receiving pressure, while others were pressed by the teeth, and their loops passed over the needle-heads, the non-pressed remaining behind until pressed over in the usual way. By using parti-coloured threads with this machine, not only would the looping be varied on the external face of the work, but a shaded variegated appearance was given to the stockings produced. This tuck presser has been applied since for other purposes.

It will be observed that by using the bar just described, an alteration was made in the operation of some of the needles at the pleasure of the workman, and a consequent variety in the looped fabric effected. This was a step in the right direction, and might have some effect in stimulating still further the attempts which had been made for some time by Roper, Bowman, and others, under great difficulties, to produce by machinery the ribbed hose, which the hand-knitters had long produced by reversing the formation of the stitches in straight lines and of various widths down the length of the hose. So great was the desire for the *fine ribbed* stockings that, previous to their being mechanically made, some which were made plain on the frame were ribbed by hand, the stitching allowed to run down through the length of the stocking, and then was looped up the reverse way by using a turning hook. One Wright, a frame-work-knitter of Ilkeston, is said to have thus hand-ribbed a pair of machine wrought hose, and sold them to a manufacturer for half-a-guinea—no great remuneration for so much labour.

The attempts to mechanically reverse the loops of the stocking-web, though unsuccessful, were much spoken of in the trade, particularly on the borders of Nottinghamshire and Derbyshire. Probably those of a frame-work-knitter or setter up, named Roper, living at Locko in that district, being somewhat notorious, were most prominently put forwards. He was a vain person, fond of company, amongst whom he was of self-indulgent

habits and apt to speak in high terms of his mechanical doings.

Mr. William Woollett was at that time, 1750, a hosier in Derby. His attention was directed to the question of how these ribbed hose could be made; and he brought it under the special notice of his brother-in-law, Mr. Jedediah Strutt, who, though an agriculturist had, he knew, been from his youth engaged in mechanical pursuits as an occupation of his mind and hands during leisure time. The reference thus made proved to be a most happy and successful one. The important results could not have been at first anticipated, nor even during the lifetime of Mr. Strutt were they fully understood. But they have been such as to have given him a just prominence amongst the inventors of that age, and to require the more extended personal account about to be given. The very simplicity of the plan he devised, and of the mode of its application to the machine of Lee, 170 years after its invention, added to the fact that no historian of the trade wrote during the next fifty years, preclude any minute detail of the obstacles he encountered. Such an account would be very interesting if it had been forthcoming. Great difficulties there must have been; for the constructive powers of mechanics in the stocking trade had not, a hundred years ago, been employed as they have been since; mainly as the effect of this effort of Strutt's genius.

Mr. Jedediah Strutt was the second son of Mr. Wm. Strutt, who, in the early part of the 18th century, was resident at South Normanton, near Alfreton, in Derbyshire; and also in the neighbouring parish of Blackwell, where he occupied lands as his ancestors had done for several generations, and where Jedediah was born in 1729. One branch of the family had occupied Newton Hall; another the old manor house near Blackwell church. He with his elder brother, Joseph, and younger brother William, received such an education as a country school of the better class could supply. Their father was chiefly anxious that they should obtain a sound practical knowledge of agriculture, in which pursuit they were engaged in their youth. Certainly the scholastic studies

of this, the most talented of the three brothers, seem to have been but slight preparatives for the mechanical skill and commercial position Jedediah Strutt eventually attained. Though unthought of by his father, it was through manufactures—by machines to be studied and improved, and by the anxieties and hazards of trade—and not by the more tranquil occupations of tilling and reaping the products of the soil, that his son was to lay the broad foundations on which have rested a superstructure of wealth, and honours, and fame. Jedediah Strutt inherited his father's tenacity of purpose and firmness of resolution. In everything else his mind, receiving but little external aid, took its own direction. He had an insatiable desire for the attainment of knowledge, and acquired for himself the elements of his intellectual character, becoming in thought, memory, and observation, a self-taught man. His thoughts took an eminently practical turn. While employing himself in the cultivation of the farm, his leisure was taken up with mechanical studies. When a boy he had constructed small mills to turn in the adjacent brook. Now he employed himself in improving a plough, or in discovering methods of subjecting the lever and the wheel to any motive power, to effect operations suggested by his fancy, or promising usefulness in their application. He seems to have acquired considerable knowledge of literature and science, though the district in which he lived presented few advantages for these enquiries. Such as there were, he diligently improved. So that Mr. Strutt became early distinguished for his enlightened mind and indefatigable efforts: giving to his inventive genius a new and efficient direction, leading at an early period of his life to the career which was unexpectedly opening before him.

On attaining manhood, the death of his uncle placed him in the farm at Blackwell; and in 1755 he married Miss Woollett of Derby, whose brother has been named above. This lady had a well cultivated mind; and in age, station, and all other respects, was well suited to him. The marriage was a happy one for both parties, and indirectly led to the important invention with which Mr. Strutt's name has been since so honourably associated.

It was now that he, by Mr. Woollett's representations of the difficulty and importance of the matter then occupying the frame-work-knitting world, was induced to make himself practically acquainted with the principles and movements of a stocking-frame; probably the most if not the only very complex machine he had ever seen; and this with the idea, no doubt at first but a remote one, of so dealing with it as to cause it to produce what hitherto had been thought to be beyond its powers. A clergyman had invented it, why should not a farmer increase its capacity for usefulness? After much labour, time, and expense, he succeeded admirably in this; by making an addition to it, or rather placing in front of it so as to work in unison and harmony with it, a distinct apparatus or 'machine'; thus between them to produce the ribbed web of looped fabric: and not, as popularly stated, by finding out the defects of Lee's frame, and devoting himself to its improvement. It is necessary to Lee's fame, as well as to Strutt's, that this should be correctly understood. Strutt left every part and movement of Lee's frame unaltered; so that when a ribbing apparatus is attached, if not put in separate action, Lee's frame may be worked, as it always has been, and produces perfect plain web: put both into co-operative action, and ribbed work is the result. Strutt's invention rests on a new and great principle; that which is at the back of the invention of Dawson's wheels, devised a quarter of a century after, and of Jacquard's apparatus, constructed a quarter of a century later still: the fact of applying external means for mechanically selecting and operating, independently of any or all others, on any individual thread or needle, lever or bar, at work in the machine, formerly only making plain web work; thereby giving power to produce fancy work of either a simple rib or spot, or the highest complexity in pattern of which woven fabrics are capable. The germ of this discovery had been hid in the selection by hand of warp threads in forming patterns on the old weaving-loom; this, its further development, was of inestimable value.

The apparatus added by Mr. Strutt consisted of an iron machine, hung on jointed arms in front of the ordinary frame. In this were

placed needles of like form with those at work already, but while the row in Lee's frame is set horizontally, these were placed nearly perpendicularly, and so as to enter between the horizontal ones. The number of needles fixed in the added machine, and their relative places on the extra bar, would correspond with the width of the ribs and number of loops to be reversed to form them. Thus, in one and one rib, *i.e.* one loop formed as usual, and the next to be reversed, and so on across the frame—by which process the two sides or faces of the web appear alike—there will be as many needles in the added machine as there are reversed stitches to be formed, one facing every other loop. When all the old frame needles have had their loops pressed, which all face the usual way, the needles of the new machine are brought by its swinging action to enter between the old ones and penetrating the loop or loops to form the rib, and these loops being passed under their beards, they are in this operation reversed, and being also pressed again, pass over the needle heads with the other loops, but with the visible part of the ribbing loops turned the other way.

Ribbed goods are variously arranged as to width of reversed stripes. For the tops of socks, wristbands on shirts, and ancle bands on pantaloon drawers, the ribs are mostly one and one. In hose from round frames this is also a favourite rib. For many years, when men's stockings were not hidden by trowsers, ribs of wider stripes were fashionable in white cotton hose. Fancy coloured striped hose were long made on these frames.

Articles are now made more extensively every year of ribbed work in wide and narrow stripes of all colours, and of each kind of material, suitable for male and female use.

The principle of Strutt's Derby rib machine remains unaltered; its operation has been simplified, however, by its subordination to automatic movement, as will be at once seen on examination of power hosiery frames lately constructed.

By the close examination of Lee's frame, which Strutt must have made in order to become fully master of its construction, he would no doubt convince himself that there had been left but little to be done in the way of simplifying or shortening the ordinary movements of the frame. The knowledge he could not but obtain during his own investigations into the construction of the machine, of the efforts of others and their ill success, would cause his ideas to take new directions. In this respect it was probably no ground

for regret that he came to the work free from all prejudices of the frame-smith or the stocking-maker. The hints which, in common with all inventors, he might gather from theories and plans floating around him, were negative rather than positive; indicative of what was to be avoided, not shewing what was to be done. He came to the conclusion that it must be something added to that machinery which was already at work in the stocking-frame, and having devised the simple principle on which it must act, by a well ordered combination of parts and motions, accomplished his task. This required great genius and skill on the part of Mr. Strutt, and was followed in due time by an ample reward.

The apparatus applied by Strutt to the front of the machine, was necessarily, when in operation, the most prominent object about the frame. This fact had probably a most important bearing on the future history of the trades. An equivalent mechanical device has been since adapted to ribbed power frames, but so closely allied to them, and as it were hidden in its operations as to almost escape notice, and challenging no investigation on the part of the bystander. Had this been the plan originally adopted by Strutt, the idea of external individual action on the needles, might have long lain dormant. But when some hundreds and at length thousands of ribbed machines were spread over the three midland hosiery counties, shewing the mechanical selection of loops; and when every workman in a plain stocking-frame, by the hand use of a pointed wire, was constantly removing loops, and thus making eyelet holes in his web; the almost necessary result was a further development of the principle. This took place within a short time; for it lies as the basis of Morris's patents of 1763 and 1781. Eyelet hole ancles and insteps were thus made in ladies' hose. Under Crane's patent, 1768, looped nets were made; and Else, in 1770, made the 'pin-machine,'—both by added operations on the needles. This principle of control and selection, variously applied and modified, produced, in succession, the knotted, twilled, stump, mesh, and point net machines. In 1769, R. Frost, by means of a perforated square hollow roller, affecting the

operations of a sliding tickler machine, and thus the working of any hook or needle at pleasure, produced the first useful imitation by machinery of fancy lace. The warp machinery operates on every thread; it being all warp, and looped sideways, each thread with its neighbour; but it is equally subjected to command as to every needle in its wide horizontal range by machinery acting, if need be, on the principle of selection. Thus, in addition to a series of inventions in fancy hosiery which caused great increase in its machinery, the large pin, point and warp lace trades of Nottingham, Lyons, and Vienna, indirectly leading to the still more extensive bobbin net manufacture of this country and the continent, owe their origin to this invention. And it is gratifying to trace here briefly, what will occupy the reader's attention hereafter more at large—the history of a simple discovery pregnant with unlooked for yet immense national benefits.

Though much attached to Blackwell and its quiet pursuits, yet the patents which were taken out in 1758, No. 722, and in 1759, No. 734, to secure the invention just described for making ribs, rendered it more convenient and pleasant for Mr. Strutt to remove to Derby, where he could superintend the carrying out of his plans in conjunction with Mr. Woollett, now become his partner: so he took up his residence there immediately. By this change he was placed in frequent intercourse with minds congenial to his own. The hosiery manufactory carried on by the firm rapidly increased, especially in these patent articles called "Derby ribs" from the town where first made. They possess the peculiarity of great elasticity, and yet tendency to cling to the surface of the limb on which they are worn. From this circumstance, ribbed goods, whether hand or frame-work, have always been much liked. The demand for the hand-knitted ribbed hose was rather increased than otherwise, while that for machine-wrought was such as very soon to bring about infringements. These issued in two trials at Westminster. The first action was against associated hosiers in Derby; the second against a like combination at Nottingham—both ending in verdicts for the plaintiffs.

They afterwards enjoyed their rights in peace until the patents expired.

The partnership received an addition in Mr. Samuel Need of Nottingham; and the business was carried on under the firm of Need, Strutt, and Woollett, until towards the expiration of the patents in 1773.

Morris's patent of 1764, which will be fully described afterwards, was an infringement of Strutt's invention. They took no notice of it; nor of Crane's in 1768, also an infringement; nor of Else's in 1770, which was an infringement of both Strutt's and Morris's patents. Though they defended their rights against combined hosiers, who injured them by making ribbed hose without acknowledgement, they took no serious steps against either Morris or Crane or Else, who though in reality all infringing, were doing so by the use of Strutt's plan, but for making very different classes of goods; and therefore though not benefitting, yet not injuring them. Not so Morris; against his poor, though exceedingly clever co-partner in building the very machine of 1764, he put the law in force on account of Else's further improvement of 1788, ruined him, and then quietly used Else's patented modifications in his own machines.

A poor imitation producing what were called pack thread ribs and soon laid aside, was made by pressing one needle and missing one. This, however, led to the making of 'sankey' and 'bird's-eye' hose.

Mr. Strutt continued in the hosiery manufacture until his death dissolved the partnership with Mr. Woollett. The family finally retired from the trade in 1805, having disposed of their frames to Messrs. Paget and Byng, for £12. each on an average.

A train of circumstances apparently as fortuitous as those which had brought Mr. Jedediah Strutt into the hosiery manufacture, opened before him in 1771, and led him into the business of cotton spinning, which, so far as magnitude of operations and profits was in question, in process of time left those of the stocking manufacture in the back ground. His position as a large consumer of cotton yarn already might dispose his mind to entertain this new matter favourably.

Nottingham very narrowly missed on this occasion

being made the seat of the cotton manufacture, which, had steam power been then available, in all probability it would have become. Coal, iron, skilled artizans, and cheap labour were as abundantly at command there as in Lancashire. If Manchester had the advantage of proximity to Liverpool for its cotton wool, the eastern counties lying so near to Nottingham secured supplies of labourers and food. The demand for cotton yarn increased as rapidly for the manufacture of hosiery as for that of the weft in calicoes, the warps of which were for a long time of linen yarn. Nottingham and Derby therefore became large markets for cotton yarn, a circumstance that no doubt led Hargreaves and Arkwright to bring their immature spinning inventions to Nottingham for protection and pecuniary support. The latter, Arkwright obtained from Messrs. Wright the bankers of that place, who, not only on this but on several other occasions, have liberally shewn the interest they take in the progress of local manufactures, by rendering assistance to rising talent and merit. But the machinery not being perfected so soon as expected—and which, if successful, would evidently render the aid and supervision of capitalists and practical men of business necessary—they recommended Arkwright to apply to Messrs. Need and Strutt. After visiting his works already in operation in Nottingham and making a sufficient investigation, these gentlemen were satisfied that the invention itself was of extraordinary importance, and in 1771 entered into partnership with Arkwright, furnishing the capital necessary for its satisfactory development from the ample means afforded by profits in their hosiery trade. Need did not remain very long a partner in the cotton spinning business.

This patent for spinning yarn by the use of rollers was obtained in 1769, and was taken out in the name of "Richard Arkwright of Nottingham, clock-maker." This was also the year in which Watt secured a patent for his steam-engine.

The first cotton mill was erected at Nottingham, and was driven by horses. Up to this time things had not progressed satisfactorily in the practical working out of the invention. Arkwright met with unexpected diffi-

culties when enlarging his scale of operations, and it was fortunate for him that Strutt brought skill as well as money in aid of the affair at this its incipient stage. One such impediment had baffled and annoyed Arkwright for a time. The fibres of the cotton wool in being drawn through the rollers were very apt to "lick," *i.e.* stick to the upper roller and wrap round it, instead of the roving going forward to the spindle clear and uniform in size. On this being made known to Mr. Strutt, he at once had the top rollers rubbed with chalk and thus cured the evil. After his entering the business, which was soon transferred to near Cromford, the difficulties both pecuniary and mechanical quickly disappeared.

In 1775 the first of four splendid mills was erected at Belper on the Derwent, that stream furnishing an ample supply of power. The construction of this large building and its water-wheel, together with the machinery with which it was filled, called the mechanical science and inventive powers of Mr. Jedediah Strutt again into exercise. The building was destined to be the precursor of other factories; by means of which Belper, then a mere hamlet, has become the second town of the county. It has been well said, "that the record of Mr. Strutt's life, as of that of many other remarkable men and public benefactors, is to be found written in his works." This eminently successful partnership continued, though after several trials to sustain the patent rights, its ever enlarging affairs until 1781, when Arkwright retained Cromford, and Strutt the works at Belper and Milford.

Meantime, although yarn of excellent quality was spun by the patentees, the Lancashire calico weavers combined against its use; a course adopted partly from prejudice in favour of hand-spinners and their yarns; and partly by some supposed adverse interests of their own. No event in the history of manufactures ever transpired of wider influence, nor has any question arisen in regard to them, on the right solution of which have hung more weighty consequences. The cotton trade of the empire was then in the balance. Happily it found its natural and just settlement by the breaking up of the confederacy. Mr. Strutt suggested to Mr. Need,

still his partner at Derby, the possibility and advantage of weaving calicoes *all of cotton*, instead of using, as hitherto practised in Lancashire, linen warps. The attempt was successfully made in 1773, the warps receiving the necessary twist and preparation to resist the friction of weaving; and thus an article was produced less costly and for many purposes more suitable than the one the use of which it rapidly replaced. The jealous fears of the bulk of the manufacturers were excited; and they soon pointed out that by law the new article was subject to a *double* duty of 6*d.* per yard and to prohibition when printed, and in regard to either class they strenuously insisted on its being rigidly enforced. Strutt and Need had made a large quantity of the unmixed calicoes, and found it necessary to encounter the odium and expense of an application to the legislature for relief. This was granted, after a severe opposition, by an Act passed in 1774, specially applicable to this manufacture, repealing the prohibition and the discriminating duty, and declaring it to be "a lawful and laudable manufacture."

The machinery for weaving the calicoes was placed and worked at Derby, in the first fire-proof mill ever erected, having brick floors laid on brick arches. The building remains, but it is now used for other purposes. Derby long remained the chief centre of the commercial business of Mr. Strutt, Belper and Milford continuing the places of the yarn production, and in consequence of the relatively increasing importance of the latter in his affairs generally, he took up his abode at Milford house near Belper, a mansion of his own construction. He gave close personal superintendence to the business. The number of hands employed was great; systematic attention was paid to their health and comfort; and their education, intelligence, and morals were objects of Mr. Strutt's earnest solicitude.

In consequence of illness which supervened about 1795, Mr. Strutt returned to Derby; where, at Exeter house, he died in 1797, in his sixty-ninth year.

An outline of the more marked lineaments of Mr. Strutt's character, may be traced with considerable accuracy from the account above given of the principal

occurrences in his business life. An intellect singularly clear and cool, was combined in him with the faculty of devising inventions and improvements, which he carried into effect with unwearied energy of mind and purpose; impressing themselves on the entire conduct of his establishments as they increased in magnitude. His tenacity of principle and moral fortitude resulted from his confidence that his determinations were founded upon truth. His convictions in regard to general views of society were equally strong. His political and religious opinions were liberal, and adopted because he thought them sound and conducive to the happiness of mankind. Mr. Strutt had the satisfaction, denied to his great prototype Lee, of realizing a large reward for his ingenuity. He had the qualities of being a good mechanic, a clever man of business, and a patron of ingenuity in those around him. He saw with great satisfaction, while building up a princely income for his family, his own interests as a manufacture were directly contributive to the national advantage. Mr. Strutt seems to have been singularly devoid of ambition for worldly distinction; he was only ambitious of the blessing that follows duty done. To promote the welfare of his family, to encourage the trade of which he had been the founder, and to fill with honour the station to which his talents, energy, and integrity had raised him, were the objects at which he aimed. These he attained in an eminent degree.

The true estimate of Mr. Strutt as an inventor is that he fixed the starting point leading the way to an immense field of invention. This is thus expressed by Blackner:

"Common justice demands of me to say that next to Mr. Lee himself, the country owes more to Mr. Strutt, than to any other man that ever engaged in the frame-work-knitting business; as from the application of his machine, the invention of every other which has been appended to the stocking-frame, has progressively emanated. From this slender but fortunate beginning of one industrious and ingenious man, have several most extensive fortunes been realized. What is still more honourable, the names of the Strutts, as patriots, stand second to none in the kingdom."

Some idea of the magnitude of the concerns of this family may be gathered from the circumstance, stated

by a respectable writer after visiting Milford and Belper, that on wishing to retire from the business about 1820, they proposed to any one who would purchase their works at a valuation, that they would allow the parties a bonus of £150,000. The extensive area over which the yarns of this, one of the two first great cotton spinning-houses, are sold and consumed, may be gathered from the fact, that from Moscow, amongst other merchandize on the road, lines of two-wheel carts each laden with its bales marked with the well-known brand of this firm, may be seen on their way to Novgorod fair; and from thence may be again passed on the route to Kiackta, the Russian frontier mart for the Chinese north-west provinces. Everywhere these marks on bale and bundle are accepted as the unfailing pledges of the integrity of the article in every respect. Equal, perhaps superior confidence is thus placed in the honour of the English makers and vendors of the goods, to the assurance given of their having been unrifled and unchanged in transit, by the imperial seals of Russia and China attached to them. When will the sentiments of honour and truth of an over competitive age be aroused to feel that the forgery of a trade mark is a flagrant robbery from the maker and imposition upon the buyer?

After the death of Mr. Jedediah Strutt, the business was carried on by his three sons, William, George, and Joseph. Some of the remarkable characteristics of the father have been perpetuated in his descendants. Having all of them been associated with Mr. Strutt in the conduct of the concern, they continued to manage it with progressive enterprise, intelligence, and success. They were also alike distinguished for literary taste and liberality of feeling.

Mr. William Strutt, the eldest son, inherited much of his father's mechanical genius. His self-acting mule was not, from some unknown cause, entirely successful. The first fire-proof building already named was built by him. He devised a system for thoroughly warming and ventilating large buildings: with improved methods of cooking, washing, and drying. Indeed he appears to have been devoted to scientific and literary pursuits.

His mansion was richly adorned by paintings and works of art. He was pre-eminent for zeal and liberality in promoting public improvements at Derby. Its institutions, especially the Infirmary, owe much of their excellence and usefulness to him. To these objects he devoted much time and money; and he was equally exemplary in private life. He died in 1830, aged 74, universally regretted, leaving an only son Edward, the present Lord Belper, who was born at Derby in 1801.

Mr. Joseph Strutt, the third son of Jedediah, resided at St. Peter's, Derby. This amiable man was a patron of literature and art. His urbanity of manners won the regard of every one who came in contact with him. His princely liberality endowed the town with the beautiful Arboretum, and helped to establish the Institute. His name is introduced here, that the noble words with which he concluded his opening address of the Arboretum, in 1840, may adorn these pages:

"If we wish to obtain the affections of others, we must manifest kindness and regard towards them. If we seek to wean them from debasing pursuits and brutalizing pleasures, we can only hope to do so by opening to them new sources of rational enjoyment. It is under this conviction that I dedicate these gardens to the public. As the sun has shone brightly on me through life, it would be ungrateful in me not to employ a portion of the fortune I possess in promoting the welfare of those amongst whom I live, and by whose industry I have been aided in its acquisition."

On Mr. George Strutt devolved much of the management of the business at Belper; and evidently imbued with his brother's sentiments, by his conduct he acquired in a remarkable degree the confidence of his workpeople. His son John seems to have inherited the like principles, judging from the following account—very characteristic of the considerate liberality of the successive members of the Strutt family, in their unwearied endeavours to secure the comforts and enjoyments of their workpeople. It is given by Gardiner, *Music and Friends*, vol. II., p. 512, after personal examination of the matter he describes. Being himself an enthusiastic lover of the Divine art, he gives it with his warmest approval, in the hope of its proving a stimulating example to other employers:

"John, the son of Mr. George Strutt, possessed refined musical taste, and rendered his neighbourhood as famous in that science, as any district in Germany. He formed a musical society of forty or more selected persons out of his mills and workshops, making a band of vocal and instrumental performers. They were regularly taught by masters; and whatever time was consumed in these studies, was reckoned in their working hours. When mustered, five or six forgemen in their leather aprons might be seen sending forth terrific notes on trombones or ophicleides. Soon after this music school was commenced, it was found the proficients were enticed away to commence as teachers of music. To remedy this, the members of the orchestra were bound to remain at the works seven years. The orchestral instruments and books, packed and placed on a pair of wheels formed a carriage, with an omnibus for performers, which could be moved to Derby or elsewhere, on public or charitable occasions. As an incentive to excellence, Mr. Strutt took occasionally half-a-dozen of the cleverest with him to London, to hear the finest singers and performers of the age. Solicitude for the happiness of their work-people and the population around, and for their social and moral advancement, has marked the conduct of the successive members of this family. They have become very wealthy; but people do not so much speak of the amount of their property, as of churches and institutes, chapels and schools, to the erection of which it is liberally devoted."

In closing an account of the second great inventor in the stocking manufacture, it seems almost impossible to avoid the thought, how strange are the contrasted events of human life; when one reflects on the melancholy fate of Lee; of Elizabeth's coldness; and his sad exile and lonely death: and then turning to the bright and usefully happy days; the long and tranquil career of Jedediah Strutt; to whom, in only the third generation, there follows in the person of Edward, Mr. Strutt's grandson, the member of the House of Commons, the minister, and at length the peer. It was in 1856 that Queen Victoria, as a mark of the interest she took in the manufacturing industry of the country, and having observed that "this important element of national wealth had not been suitably represented in the Upper House," expressed, through Lord Palmerston, her intention of conferring on Edward Strutt, Esq., of Kingston Hall, Nottinghamshire, the honour of the peerage. He paid a graceful compliment to the town of Belper, as the scene of the commercial enterprise and prosperity of his family, by adopting its name for his title. Few modern peerages have been better earned, or the bestowal of which have been more generally acceptable to the country.

CHAPTER VII.

MODIFICATIONS OF THE HOSIERY-MACHINE.—1760 TO 1800.

Lee's stocking-frames had now been known and used in Spain for many years, and silk hose made upon them had been imported into France and England. About the year 1700 open work mitts and gloves, and hose ornamented with eyelet holes made by using the work needle or hand ticklers, and which had also been embroidered by hand, were imported into England. These were quickly imitated here, but still by hand. The introduction of Strutt's added machine led to many attempts to make these eyelet ornaments by machinery applied on the like principle. These efforts were generally carried on with much mystery, for the profit anticipated from success was very great, as the wages obtained by hands making such work were *5s.* to *7s.* a-day if diligent, at a time when meat was only $1\frac{1}{2}d.$ per lb. and bread in porportion.

Amongst those who were thus engaged was one Butterworth, a stocking-maker, living near Mansfield, who devised a plan which he was obliged to confide to Betts, a smith working in his neighbourhood, in order to carry it into effect by the construction of the necessary machinery. This was in fact a union of the principal parts and movements of the tuck presser and Derby rib to be added to the stocking-frame. By it the tuck presser brought the stitches which were to be shifted to the needle heads. These were removed to make the eyelet holes by short flat and pointed ticklers or points cast in leads and fastened to the tickler bar. They had two eyes at first and were brought in a parallel direction to the needle heads; and then when the stitches were on the ticklers, they had a side or shogging movement given to all of them, by which these stitches were placed

on the needles intended to receive them. From the history of this and several after inventions of this period, it will be seen how difficult it is sometimes to allot with perfect certainty the meed of credit and praise due to each respectively, who laboured in this field of constructive operations often for years in the nearest proximity to each other, and not unfrequently with the like end in view. To supply the money to complete this invention, was beyond Butterworth's means; through Betts it was obtained of Ferdinando Shaw also of Mansfield, and probably on the responsibility of Betts. The latter being fully possessed of the plan, and having an insight into its importance and value, threw Butterworth aside apparently without remuneration; and as Shaw became either unable or unwilling to furnish the further funds necessary to obtaining a patent for the invention, Betts made overtures to Mr. John Morris, a hosier of Nottingham, who accepted them; and with Betts and Shaw proceeded to London, where the patent was taken out in 1764, No. 807, in the names of Thomas and John Morris and of John and William Betts:

"For making by a machine to be fixed to a stocking-frame eyelet holes or *net work*, having an additional row of frame tickler needles."

In Shaw's absence, but while the three remained in London, it is related that Betts sold the entire interest in the patent to Morris. This information with what follows relating to Shaw was received by G. Henson from Roland, the inventor of the *double lap warp* method of making hosiery, who was born about 1750 and died in 1838. This person said he had worked for Shaw, and knew Betts and Morris well. Shaw having been promised his share of the profits to be realized under the patent, was so chagrined by the transfer to Morris without any remuneration to himself, that he proceeded to the Netherlands to set up the manufacture there. He visited the chief places where hosiery and lace manufactures were carried on—Brussels, Lisle, Tournay, and Valenciennes, but met with no encouragement. At the latter city he saw a widow making mitts and handkerchiefs in imitation of Spanish open work, by, to him, a

new method. A warp was framed in an upright position, the threads of which were made fast at the bottom. They were platted by hand and kept from unplatting by the insertion of pieces of thin wood whilst a new series were similarly platting. After about twenty-four of such layers had been made, the bottom end of the frame was withdrawn and the platted work fastened. Each layer produced a row of eyelet holes in the web. She was then making silk mitts with comparative ease and rapidity, and he found that they could be thus produced at a lower cost than the tickler mitts, the machinery for making which he was wishing to introduce. He brought the widow and her plan to Mansfield, and as the apparatus cost little, he soon made great progress in its use. But Morris, upon this, having the help of Else's inventive genius in improving his machinery, ruined Shaw by lowering the prices for his tickler-machine wrought goods; and in consequence part of these Netherlands wooden frames were sold to Mr. Fellows, of Nottingham, and part to Mr. White, of Chesterfield.

It is true that this statement about Shaw's wooden frames coming into Fellows' hands is altogether contradicted by another account, which is to the effect that two Swiss mechanics, after seeking in vain to dispose of such machines elsewhere, brought them to Nottingham and sold them to Mr. Fellows, who worked them near Weekday Cross, and is said to have obtained a patent for the plan, but this has not been ascertained. The peculiar mode of placing and using the warp threads here described, was so frequently adopted by those who many years after sought to find out methods for making platted lace by machinery with rapidity and at a moderate cost, as to lead to the saying that this machine opened the way in a more especial manner to the construction of lace machinery. But the course of invention which has yet to be described, as it is that most generally accepted, is also most natural and probable. The eyelet hole machine, by the facility with which the covering tickler could be used, was the first step really taken after Strutt towards making lace from the stocking-frame. A. Else, by getting rid of one eye in the form and use of these

ticklers, so improved them that this class of machinery has in consequence spread over every country where hosiery-frames are employed.

About the year 1770, Else and Harvey took the "pin" machine which they had constructed, from London to Nottingham. Haynes allowed Harvey £50. a-year, during Haynes' "point" patent, not to work Else and Harvey's invention.

It was extensively used in the latter place for some years afterwards for making lace, but from some unknown cause it ceased to be employed. Excepting that it is said to have had one crank pin to each needle, its construction, mode of operation, and the kind of article it then produced, have long been forgotten in England. But this machine was soon introduced into France, where, after a series of modifications, it became the prolific source of employment and wealth. The Convention gave a large sum to Rhambolt for getting this English frame; and it is from machines made on the principle of this, but considerably improved, that at Lyons the large production of the single and double silk net is obtained; as also the like articles now extensively manufactured in or near Vienna. These goods are known and used wherever lace is consumed. Harvey, when asked in 1812 to describe the pin-machine, could not; he had forgotten his own invention. Had there been a museum for the reception and conservation as well as public exhibition of machinery and its products in Nottingham—and such there ought to be in every seat of manufacturing industry—this and other now unused and forgotten ingenious combinations would be rendered available, not to gratify an idle curiosity, but for useful examination and reference. This has long been desired by the more considerate and fore-seeing amongst both inventors and experienced manufacturers. It would become an explanatory pendant of the best kind, to that increasingly useful institution in Nottingham—the local corporation patent office, should both ever become placed where the machines can be examined easily with the specifications and explanatory maps.

A patent was taken out by John Morris in 1781,

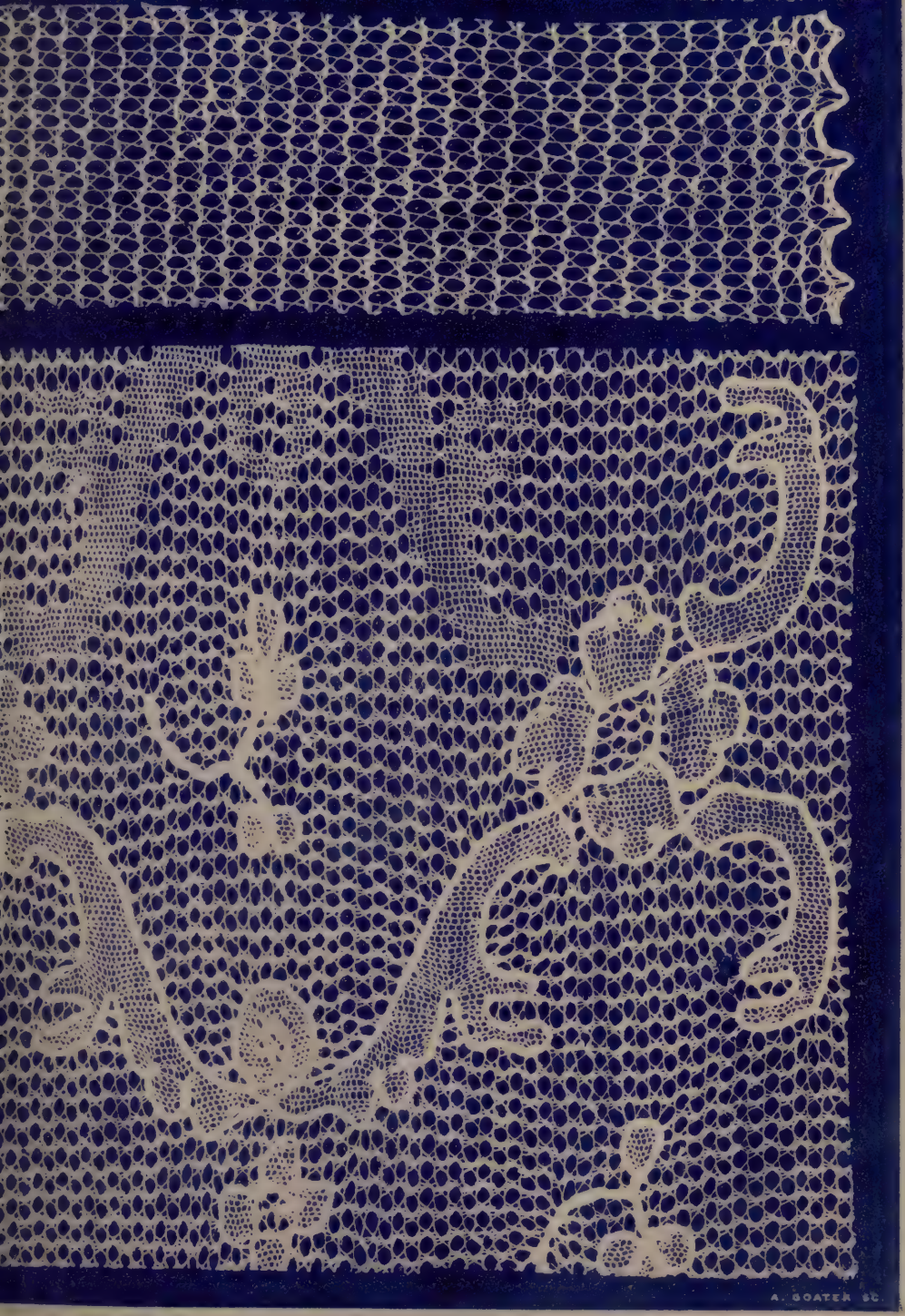
No. 1282, for an improvement on the patent of 1764; whereby the sinker loop was put across two needles making *point net;* these may be taken together as an invention almost equal to any brought out between 1760 and 1800 in these trades. Attempts were made to avoid the rights of the patentees. Some worked with hooks instead of points. Some placed them differently. The following case was curious as to the facts, and is often referred to as an important judicial statement of the law:

Upon the trial of a cause, Morris *v.* Branson, in 1778, before Lord Mansfield, for infringement of this 'tickler' patent, evidence was given that by the use of a telescope in the early morning from the upper hill of Nottingham Park, opposite to Branson's open shop-windows, the machine was seen at work. Upon proof being given of this fact, the wife of one Mayo swore *she* had invented the machine, and used it before the date of the patent; which statement was supported by her husband. It was also pleaded that the patent must be for, substantially and essentially, a new invention; whereas this was only for an addition. A juror pointed out that this objection would destroy every patent right. The jury found for the patentee, with £500 damages—a verdict in which Lord Mansfield acquiesced. The court held, that "to effect by machinery in any mode the working of a whole course or row of loops at once, that which, before Morris's patent was done loop by loop singly by hand, was an infringement of it." Branson took his frames out of the country, but was overtaken when in sight of the French coast. On submission and giving up the machines, the fine was remitted. Morris agreed that he would employ him on a rent for the machinery. Mayo on his way also to France was taken by a press gang, sent to sea, and not heard of again.

Now that modifications of the stocking-frame had begun, they were vigorously carried on. Else, assisted by a stocking-maker, Hammond, discarding the tuck presser, devised an apparatus regulating the tickler's operation on a sliding needle bar, and giving a side motion to remove the stitch by the tickler alone. This nearly doubled the speed over Morris's plan. It was on the use of this plan that the latter brought his action for infringement, which it certainly was, of Betts' (or Butterworth's) tickler. Why Morris bore so hard on Else is not known, as the former had the reputation of generosity in paying high wages for the making of his goods under the patent. It is worthy of notice that Morris took out his patent *for the work, as well as the machine.*

A figured lace-web was first made in 1769 by

PLATE 10.



A. GOATER SC.

Mr. Robert Frost, on a frame arranged by Thomas Taylor, of Nottingham.

A slide lever tickler was used to every needle, and those which are desired to operate, being pushed forward by a carved roller, on the principle of an organ or chime-barrel. This roller had projecting points on the surface, adjusted according to the requirements of the pattern; these pressed on pins at the ends of those tickler slides which were required, leaving those not wanted to remain at rest. There being one of these ticklers to each needle, any stitch in the course or row could be moved at pleasure, and any pattern produced."

In 1767 velvet pile web was made on the stocking-frame, under a patent taken out by Ross and Donetti, who produced the article chiefly in London and Edmonton.

The mode of procedure was to add a slack course to a stiff one; and a wire being passed through every second loop taken off by a tuck presser in the process of forming the row or course of loops across the frame, left long loops on the face of the work, which before the wire was drawn out were cut, and left a loose pile.

It was unsound, in consequence of the velvet pile drawing out, and its use was soon discontinued. Nevertheless Ross had a great sale for it at first; paid his workmen a shilling an hour wages, and retired with a competency, dying in London in 1786.

Josias Crane and J. P. Porter patented, in 1769, No. 940, "a machine in which is fixed a set of slides added to a stocking-frame." It was for shading, brocading, and flowering in gold, silver, &c. mitts, gloves, hoods, aprons, &c. in all shades of colour. It was a beautiful article, but required more than an ordinary share of ingenuity in the workman.

The needles were not cast into leads, but had small bits of iron affixed to them, and were placed in grooves on the needle bar, with a string fastened to each. There was a cylinder roller put into operation from behind the frame. A *drawboy* brought back the needles necessary to produce any given pattern, while the workman placed coloured or other threads of silk, &c. on those needles that remained.

Inlaid or shot brocade was afterwards made by means of added thread carriers and ticklers operating on different needles. (These thread carriers were destined to become most important additions to all looping frames). Thus most rich waistcoat-pieces were produced. But the cost, added to a change of fashion, laid them

aside. Crane gained little benefit from his invention, and died a poor man.

Having described this machine, Blackner, with the true prescience of an ingenious man, enquires, "might not the *drawboy* have been dispensed with, by pricking patterns on a cylinder like a tune on an organ-barrel to be turned by the foot?"

A person named Broadhurst, of Nottingham, reversed Frost's plan above described, by the following method:

The cylinder was placed in front of the frame, and had iron pins driven in upon its surface to form the pattern, with spring ticklers to press into the eyes of the needles, and the stitches were removed without touching the needles.

The fabrics made on this class of machines were of two kinds: one an opaque stocking web, and eyelet hole pattern; the other an eyelet hole ground, and figures of stocking fine looped web.

Not being of fast mesh and liable to break into large holes, the article went out of use here. Rhambolt took this machine also to France in 1785, where it continued in work for more than thirty years.

In 1771 Richard March and William Horton took out the patent, No. 991, for machine knitted or knotted hosiery; and in 1776, No. 1120, a patent was granted to W. Horton for knotted and double looped work. Under these patents most excellent and durable articles were made.

This was effected by replacing the long covering ticklers, using a short shouldered *point* to every needle. These points are passed into the loops, and by a clever side movement raise and place each loop on the next needle to that on which it was wrought. It thus becomes *knotted*. By turning the rack one way a given number of courses, and then turning it back a like number, a ribbed lustrous article is made; or if the rack is alternated every course, shaded work is produced.

The use of this kind of hosiery has varied greatly at different epochs. In 1795 the demand was supplied with difficulty by 1000 frames; ten years later not more than fifty were employed. They have since more than once become fashionable both at home and abroad. The great defect of knotted work is their coarse appearance, though made from thirty to thirty-four guage three-needle silk frames. The finest in the world was

a forty-six guage built by consul Le Brun (colleague with Napoleon Buonaparte) who established a manufactory for frame-work-knitting at Dordogne in France.

Mr. Wm. Horton was a native of Hinckley. On account of some youthful indiscretion, he removed to Chacomb, in Northamptonshire. He began life probably as a stocking-frame repairer and setter-up. It is certain that he very early acquired an intimate knowledge of the principle and working of the machine. The former he conceived to be perfect: but devising means of modifying the latter became the ruling passion of his long and useful life. Seeing a workman making the diamond in the hand of a glove by tucking or knotting it, the plan was suggested of making stockings wholly of knotted work. This task he accomplished ultimately, using John Lindley's tickler machine, in which every other loop was knotted; also imitating Else's plan, with a novel combination of other parts. Horton aimed at and succeeded in knotting every loop; thus making an elastic as well as sound fabric; it was knotted so fast that it would not run on the thread being broken.

His finances were low while constructing his frame, and he fell into an additional difficulty by the serious injury of a new ordinary stocking-frame, while taking it to its destination on the back of a pack horse. A friend assisted him with money: but his resources becoming exhausted, he went to live in London; and there finishing his newly invented frame, succeeded in gaining the confidence and co-operation of Mr. March, a hosier; it was patented as above stated.

Difficulties occurred in the perfect working of the frame. The patentees offered a reward of £20 for the remedy of a defect in the points. Peet, a master stocking-maker, devised a shoulder or elevation in their shape. When shewn to Horton, or to March, he exclaimed, "that is what I wanted"; applied the improvement, but merely gave Peet as his recompense employment on liberal terms. Betts, another workman of Horton's, was fortunate enough to still further improve the working of the points, and is said to have received £50 for his skill. Nevertheless the then well-known

Centlivre Stevenson, a Nottingham workman, also claimed the merit in this matter.

An impediment to safety in having to move the points half a needle in knotting, was removed by placing horns on each side the machine, so as to prevent it at that moment from moving at all. This was a masterly arrangement; but by whom devised is not known.

Horton built his machines in great part thirty inches wide; but two he constructed fifty-four inches in width. His workmen at Godalming were greatly excited at their size; called them Gog and Magog, and refused to work a web upon them of more than thirty-six inches in width. At length a giant in strength, one Whitehorn, worked Magog in its full width for twenty years; making fleecy great coats upon it, and driving it faster than ordinary hands could work frames of the usual width.

Mr. Hooley of Nottingham infringed upon this patent. When legal proceedings were threatened, he removed to Scotland and there established a rival manufacture.

Mr. Horton was a man of indefatigable industry; and though he had realised a handsome fortune, yet, at an advanced age, was still to be seen repairing or improving his frames, with all the assiduity of his younger days. He was as remarkable for the simplicity of his tastes and habits as venerable for his years. He lived to see the dawn of the day when the hosiery manufacture, by singularly unexpected developments in its machinery, was relieved from the deplorable dearth of employment and consequent miserable rate of wages, which during the latter half of his life, had so grievously reduced the condition of the greater portion of the hand-loom-workers in this trade.

An imitation of knotted work was made by William Brockley, a poor working man of Nottingham, in 1776. If made by one kind of operations they were called *twilled*, if by another *plated* goods.

He applied to his machine as many ticklers as there were needles. He used them in a new method, simple and ingenious, and when once seen, very obvious. He placed projecting arms or 'dogs' to cover the tickler or horizontal sliding bars, modifying the use of these latter instruments; he then made two or three courses of thread, one of them to be shogged one or two needles sideways according to the desired pattern.

By this method the web lost its looped appearance

and assumed a *twilled* face. By removing the twilled stitches to the right or left, a kind of stripe might be obtained. The article being non-elastic was after a time abandoned.

These twilled goods could be made with a silk face outside and a cotton one inside, by carrying a cotton thread at the back and the front thread of silk. They were then called *plated* hose, were of brilliant appearance, and came at a moderate price. So long as the back was made of a *double* cotton yarn, they would wear well; but when single yarn was introduced, the credit of plated goods rapidly declined, and the production became extinct.

This adaptation of hosiery machinery was the means of giving for years a large amount of employment to workmen, and by its use several manufacturers gained fortunes. It led also to several other important and useful modifications. But the genius of Brockley met with no corresponding reward. No generous remembrance of his past services to the trade reached his poverty-stricken dwelling; and he died at Nottingham in very humble circumstances.

Another of these ill-requited ingenious men was Mr. Robert Ash, a mechanic of Nottingham; who, in conjunction with Dalby of Leicester, about the year 1781, devised and patented, No. 1300, a method for making "a new kind of fastened platted work." This was a machine to produce a twilled fabric that should be properly elastic, and have the exact appearance of the knotted hose, by the use of Brockley's twilling machinery, to which he added a long and knobbed wire. This divided the work by a double tickler. The loops were twilled in a very complicated but ingenious manner, the discovery of which presented points of great difficulty. The complexity of the machine may have prevented its extensive use; thus rendering Ash one of the unfortunate inventors; yet its merits were such as to justify his claim to high credit as a mechanician.

The article made from it was plated as well as elastic; it was a close imitation of knotted twills, yet at less cost. But it was coarse in appearance, and was

in consequence chiefly exported to the West Indies and South America.

An improvement upon this plan of Ash's, was made by Samuel Hague, who, in 1790, was enabled to take out a patent, No. 1777, for it, "as a machine added to the stocking-frame."

It was for making elastic double knit goods, by placing an apparatus containing instead of the former wires others called stumps, cast into leads so that they operated over and parallel to each needle, and thus did away with the presser.

This was called stump work, &c., an elastic and eventually a *plated* fabric, known as the product of the "mesh" machine of Eaton, Green, and Hague. Hague appears to have sold his invention to Messrs. Watson's, of Nottingham, on condition of receiving over and above his charges for applying the necessary apparatus, two guineas as a bonus for each stump machine they should employ through him. On some disagreement, the frames were placed in other workmen's hands, and Hague lost his reward, which he asserted had previously been ill paid. This was not to be easily credited, considering the respectable position of the house in question, the smallness of the royalty, and beyond all, the peculiar characteristics and habits of the inventor, as narrated by G. Henson:

"There was living in Nottingham at this time" (1770 to 1790) "Mr. Samuel Hague, one of the ablest yet most improvident of men. He had received an excellent education; was by original trade a baker; but followed several other occupations, chiefly that of a schoolmaster, in which he has scarcely ever been equalled, notwithstanding his irregular habits. It is said, he could write at the same time with both hands; could solve problems in Arithmetic and Algebra without figures by mere rumination; even in his cups could rhyme extemporaneously, not in mere doggerel but in genuine poetry. He knew music and sung well; turning out in dark nights 'to raise the wind' by singing his own songs, and selling his auditors slips of old newspapers cut to resemble them put into print. But Hague was a great mechanic, and surpassed the greater part of his able contemporaries. By mere dint of genius he enabled himself to adjust the parts of machines and combine them, following the employment of a setter up for a considerable time. It was by the enlightened skill and perseverance of this versatile genius, that this elastic twilling machine was perfected."

Hague had attempted so early as 1777 to solve the problem of making twist bobbin net, but without success.

He used a horizontal warp, winding every other of its threads on a long wire, which wires and threads were made to pass over and under the remaining threads. But he could not pass them more than half round, and abandoned the attempt, never after renewing it.

He agreed, in connection with John Eaton, to take out a patent for the *mesh* machine, and having, amidst the vicissitudes of his changeful career, acquired some money, advanced it to Eaton for patent purposes. Eaton expended it in a most improper way, and returned from London without the patent. This so straitened Hague's circumstances that he never recovered from the loss, and died extremely poor.

These wire, stump, and mesh stockings were more elastic than the original twilled ones, and so acquired the name of *elastics*. On all these kinds and their imitations the hose are made *sideways*, *i.e.* the width of the frame gives the length of the stocking; the frame is therefore twenty-eight to thirty-four inches wide. At one time 300 frames were employed on elastic work; in 1830 they had dwindled down to fifty. For many years after these goods were first produced, they were much admired at home, and were also largely exported, especially to the West Indies. At length over-competition caused the hose to be reduced in size much below what they were called and sent out for; the markets rejected such attempts at deception, and finally the articles ceased to be ordered, and the manufacture was ruined.

In 1784 John Webbe, of Birmingham, with Captain Whittle, of the Oxford Blues, took out a patent, No. 1417, for a simplification of the Derby rib with a more easy and perfect division. There were at one time 300 of these machines worked at Banff, in Scotland, with great advantage. About 1790 Rhambolt took them to France, and many were constructed at Paris, being employed in the increasing hosiery trade of that city and elsewhere.

Articles fitted to the size and shape of the upper part of the body, and to be used next to the skin for vests, drawers, &c., whether hand-knitted or machine-wrought, have always been found conducive to the com-

fort and pleasure of the wearer. These have been made of animal wool on account of warmth, and cotton for economy in cost, and silk because of its useful electrical affinities. Bandaging of elastic hosiery web for surgical purposes has long been used. Such articles of hosiery to be made warm with fleecy insides in order to secure the ease and health of those who used them, and even to assist in the cure of some painful diseases, began to occupy the serious attention of Mr. George Holland, a hosier in London, some time before the year 1788. In that year he obtained a patent, No. 1670, for the manufacture of this class of goods, under the names of "Fleecy and Segovia hosiery, made from superior prepared wool for under-clothing. It is specially adapted for use by warmth, lightness, elasticity, and absorption—qualities which it possesses in an eminent degree, to prevent, or at least operate beneficially in many chronic complaints." He took out in 1790, No. 1738, and in 1782, No. 1901, patents for further improvements. By these Mr. Holland derived large pecuniary advantage.

This house long retained under his successors the celebrity justly earned by their skill and attention to the peculiar processes, necessary to insure the confidence of the medical profession and of consumers, in the hyginenic qualities of this manufacture. The fibres of wool are laid on the stems of the needles of the stocking-frame in front of the web, and of the loops before they are pressed over the needle-heads. They are by this means sufficiently incorporated with the inside of the web; and yet will allow of being combed out into the soft fleecy covering required.

In 1799 John Eaton patented, No. 2325, "a machine to be added to the hosiery-frame for producing elastic and stitch and plated hosiery." This seems to have been an unimportant change of the apparatus used for these purposes, combined with the common frame.

In 1800 Thomas Penn patented, No. 2427, an improved mode of sinking, locking, pressing, drawing back the needle-bar and keeping up the jacks in the stocking-frame. As the object professed to be sought in this invention could only be obtained by the entire modification of the working parts of the stocking-frame,

its not having been generally, if at all, adopted, shews that it was not approved. Nothing can now be known, except from the specification of its intrinsic value.

The above closes the list of patents for inventions up to its date used in the manufacture of hosiery by machinery. Many others were obtained during the last half of the 18th century for the production of lace, upon the stocking-frame modified. These will form the subject of the next chapter. The present one will be concluded by a brief description of the occurrences transpiring during that interval, amongst those who were engaged in the trade.

Notwithstanding the inventions by which the use of the stocking-frame was modified, the wages and profits realized upon the great bulk of the machinery in the trade from 1750 to 1780, were very slowly, partially, and indirectly benefitted by them. The trade still laboured under the constant influx of too many apprenticed boys and girls and non-freed workmen. This led in 1776-7, to the formation in the midland counties of a Stocking-makers' Association for Mutual Protection. This body became so powerful in Nottingham, as to influence, if not control, the return of members to Parliament in favour of their trade. Mr. Abel Smith was thus returned without opposition in 1778, when the members of this association marched in procession before his chair, which was gaily ornamented with the then newly invented white silk lace. Flags inscribed with mottoes indicating strength and unity were borne aloft, accompanied by two assistants, Mr. Reynolds, their clerk, and other deputies of the London Frame-Work-Knitters' incorporated Company. These had come down with Pilkington their counsel, who brought with him a pamphlet written to aid specially upon the occasion. This formerly authoritative body had another opportunity thus given them, of retreating from their coercive and unreasonable exactions, and by wise and timely measures, to have rendered themselves useful between the master hosiers and their discontented workmen. The novelty of high rents exacted for frames, with other charges, had not yet settled into a legalized custom; the best of the journeymen and wisest of the

masters might have been conciliated, and the operation of the charter revived; but the time was wasted in squabbles about fees, and the company lost almost its last hold on the trade.

Petitions were presented to Parliament by Daniel Parker Coke, Esq., M.P. for Derby, during the Session 1777-8, from the frame-work-knitters of London, and of the counties of Middlesex, Surrey, Nottingham, Leicester, Derby, Northampton, and Gloucester stating that—

> "The petitioners had served a regular apprenticeship to their business, but were unable with their utmost industry to obtain by their labour the common necessaries of life, by reason of low wages, frame rent, and other charges made upon them, incident to the working their frames and keeping them in repair—"

and asking for a Bill to settle and regulate their wages. This petition was referred to a select committee of the House of Commons, who reported in favour of a Bill to fix the rate of wages for each guage, size, and quality then made, being brought in. But this was refused upon a division, by fifty-two against twenty-seven. This Bill, if passed, would have been ineffectual, as it did not specify exact fineness in the kinds of work to be paid for.

The employers in the silk branch of the trade soon after sought to reduce the prices paid for work, 25 per cent., or 6*d.* to 10*d.* a pair; and great excitement was the immediate result. This induced other classes in Nottingham to subscribe in aid of resisting this reduction. Mr. Meadows, one of the members for Nottinghamshire, introduced another Bill in 1779, having the same objects as that of the previous year. This was strenuously supported by Mr. Robert Smith, (afterwards Lord Carrington), who said "the measure was moistened and saturated by the tears of the poor distressed families of frame-work-knitters." Leave was given to bring in the Bill with only one dissentient voice; it was so introduced, therefore, at once; and read a first time. The second reading was carried by twenty-four against twenty-three. But it was thrown out upon the third reading by a majority of fifty-seven to eighteen. Upon this great disappointment, riotous proceedings took place on the part of the workmen at Nottingham. Three

hundred of Need's frames were broken, houses sacked, the riot act read, and soldiers called out before quiet was restored.

The hosiers had formed a union of their own; and issued an address after the ferment had subsided, stating that they would oppose all regulations, whether by charter or acts of Parliament, as tending to drive the manufacture to France, where workmen were contented with low wages. These results were repeated in 1783, and again in 1787 and 1790.

Trade seems to have revived somewhat at the close of the war with our American colonies; and wages in the hosiery business were improved. The hands employed in making the usual plain cotton and worsted articles earned 10*s.* to 12*s.*; in silk, 10*s.* to 14*s.*; and those who were engaged in producing the goods from newly modified machines, as knots, twills, and elastics, could earn from 18*s.* to 30*s.* a week. Hose with long or eyelet hole clocks, increased the wages one-third above plain.

By an enumeration of the stocking-frames in 1782, they amounted, in the three kingdoms, to about 20,000. There were only 500 in London, 200 in Surrey, 650 in Tewkesbury, 300 in Northamptonshire, a few in Scotland, 700 in Dublin, and 300 in Cork. In the three midland counties there were found to be 17,350; and the business became from this epoch concentrated in Leicester, chiefly for woollen; Derby, for silk; and Nottingham, for cotton hosiery. The manufacture of hosiery in London was sustained on the very limited scale above indicated by theatrical and other bizarre orders for another half century. The last noticeable act of the London Company of Frame-Work-Knitters seems as strange as disrespectful to civic authority. In 1835 the corporation of London desired a sight of their letters patent, charter, and other records: but the requisition was peremptorily declined by the court of assistants.

From 1780, in consequence of the system of rent-charge for the use of stocking-frames having become fully established, the construction of new machinery proceeded very rapidly for the next thirty years. The

cost bore so small a proportion to the rent, as to induce many persons not in the trade to purchase them.

Mr. Gardiner, in *Music and Friends*, vol. II. p. 810, gives a few interesting notes in regard to the early history of the manufacture of hosiery in Leicester, derived from his uncle Coltman, who was engaged in it in 1768. He states that:

"One Allsop took a frame in 1670 to North Gate Street, Leicester, but from prejudice against *woven* stockings, he found difficulty in vending his own work. However he took J. Parker of Leicester as his apprentice; and in due time Parker took Samuel Wright a quaker for his apprentice. These are said to have been the only stocking-weavers in Leicester for some years. About 1700 the making worsted hose became a trade in Leicester. In 1750, when there were about 1000 frames in the town, the principal manufacturers were Mr. Lewin, Messrs. Barns, Chamberlain and Burgess, Messrs. Cradock and Burney, Mr. Thomas Pougher, Mr. Richard Garle, Sir Arthur Hazelrig, Mr. Joseph Cradock, Mr. John Williams, and Mr. William Miles. The chief articles made were white and brown thread hose; the white thread was imported from Silesia; the brown thread was obtained from Scotland. About 1000 dozen of worsted hose were made weekly for home consumption. The greater part of the dyeing and trimming of Leicester goods was done at Nottingham, where Elliott charged for dyeing hose black 3*s.* 6*d.* a dozen. The hose for the lower orders were at that time mostly of a pink colour; those for the higher ranks were pearl-coloured with scarlet ancle clocks, made long enough to reach to the top of the thigh and to turn down towards the leg."

The clever writer of this interesting work was a descendant of Thomas Gardiner, a Leicester bleacher, who first introduced the plan of whitening worsted hose by the fumes of sulphur. Thomas Gardiner, his son, born in 1743, was placed when young with Chamberlain and Burgess, then the greatest hosiers in Leicester.

"This house, and their fellow manufacturers, distributed their productions all over England, sending them on the backs of pack horses. William Gardiner, the author, was born in 1770; was apprenticed to, and afterwards in partnership with, Thomas, who died in 1837, aged ninety-four. They related, that in their earlier years every village had its wake; the lower orders lived in comparative ease and plenty, having right of common for pig and poultry and sometimes for a cow. The stocking-makers each had a garden, a barrel of home-brewed ale, a workday suit of clothes and one for Sundays, and plenty of leisure, seldom working more than three days a week. Moreover, music" (of which Mr. Gardiner was an enthusiastic and well-versed amateur, he says) "was much cultivated by some of them. Even so late as 1800 the larger part of all the frames in Leicestershire were the property of the master frame-work-knitters, not of the hosiers."

Although the statement that the Rev. Mr. Robinson, an inhabitant of Leicestershire, was the inventor of the stocking-frame, was not founded in fact, yet it was introduced very early into that county. It was taken in 1640 to Hinckley by one William Iliff; 150 years afterwards there were about 1000 frames at work there. It had become the centre of production for the coarser qualities of cotton and woollen hose, chiefly the former. Such it has remained through many vicissitudes to the present time. In 1844 there were 1750 frames, chiefly 20 and 22-guages earning the miserable pittance of 5*s*. 3*d*. a week. At the present time there are more frames than hands to work them, and the hands are receiving adequate wages.

The use of cotton yarn as a material for machine-wrought hosiery, was at first necessarily very limited from its high price, being imported from India, where it was spun into fine numbers of single thread, and if destined to be made into stockings it was doubled, trebled, and even made into four and five-fold yarn. This duplication of the number of threads caused the hose to be so costly that to shew the fact, the custom was established of putting as many eyelet holes in the welt as there were threads in the yarn, and the plan became universal whatever the materials might be. But after a time, when two threads only were used in cotton yarn, and at length one thread carefully twisted was found to be workable, the hands were directed still to make the greater number of eyelet holes, and thus so far to deceive the purchaser as to the quality of the hose in regard to their wear. A petition to parliament in 1765, from the masters and work people of Tewkesbury, where there were about 600 frames, set forth this fraud as a grievance requiring legislative redress. An act was in consequence passed for that purpose, but it was so worded as not to be of any effect. Hose made of two threads and of single yarn have ever since been made and marked with as many eyelet holes as the hosier has pleased. But stockings made of the two-thread yarn, now produced of far superior regularity and consequent strength, having three-thread heels and toes, have so much greater durability than those made from single yarn,

that as the cost of making them is alike, it is much to be regretted they cannot be more easily and with certainty discriminated by the buyer. The outcry of careful housewives when repairing fractures in their texture would be mitigated and the character of the hosiery trade better established.

It has been found by long observation and experience that the softness and pliability necessary to easy and safe working of cotton yarns in hosiery frames, by reason of the liability of harshness and irregularities to break the needles as well as to produce unsound work, is best secured by the use of South American (Pernambucca) cotton. Even with this as the raw material, hosiery yarn is the most difficult class to spin well. A long course of improvements have issued in fixing at Staley Bridge and Ashton-under-Lyne the larger part of this now very extensive and important business. From thence, Belper, and Cromford, hosiery yarn has long been distributed to all parts of the world where the manufacture of hosiery is carried on. Mr. J. R. Allen, hosier, of Nottingham, placed in the London Exhibition 1862, an interesting series of hose manufactured by his father and himself. Amongst them were stockings made in 1790, from five-thread cotton yarn spun by Arkwright, in the first cotton mill which was erected in Nottingham, and from two threads produced in Cromford Mill, spun successively in 1804, 1810, 1812, 1815, 1826. The advance towards excellence of quality in the materials, was clearly perceptible throughout. There were goods from "Lisle" thread made in the years 1848 to 1858, shewing great improvement also in the quality of the yarn. This "Lisle" or "Scotch" thread, as it is sometimes called, is higher twisted and prepared with special care for gloves and hose of a fine texture, the looping being clear and of great regularity.

CHAPTER VIII.

HAND MADE LACE.

It was by various modifications of the stocking-frame that lace was first made upon machinery. These changes were continued through the years intervening between 1760 and 1800. The business was established, and, as respects the hosiery manufacture, for the most part separately carried on from the former date; and this included a course of mechanical improvements down to the present time. It will be desirable at this point of separation, and for the better comprehension of the subject of lace, to state briefly the nature and previous history of that fabric itself; the latter, so far as can be gathered from the notices which have come down to us in ancient writings, and in the monumental representations of this kind of ornament, which have survived the ravages of time.

Dr. Johnson defines net-work to be "anything reticulated or decussated at equal distances with interstices between the intersections." This is a very correct, though not a popular explanation; happily the thing itself is sufficiently known so as not to require more than a description of the principal modes in which the work is performed. The varieties of net-work are almost infinite; the methods of production must be equally diversified.

Nature herself was the first to exemplify, and that in the most beautiful and perfect form, the learned Doctor's definition. Whether the first thought of lace as an ornament was derived from a plant cannot be known; but its most perfect forms have ever been obtained from leaves and flowers.

Mr. Ellis, in his work on Madagascar, thus describes that singularly interesting plant, the "Ouvirandra

Fenistralis," or "lace leaf," introduced by him into England. It may be seen at Kew Gardens and elsewhere:

"This is not only a very curious, but to the natives, a very valuable plant as an article of food. It is singularly beautiful both in structure and colour. From the several crowns of the branching root, growing often a foot or more deep in the water, a number of graceful leaves nine or ten inches long and two or three inches wide, spread out horizontally just beneath the surface of the water. The flower stalks rise from the centre of the leaves, and the branching forked flower is curious, but the structure of the leaf is peculiarly so, and seems like a living fibrous skeleton, rather than an entire leaf. The longitudinal fibres extend in curved lines along its entire length, and are united by thread-like fibres or veins, crossing them at right angles from side to side at a short distance from each other. The whole leaf looks as if composed of fine tendrils, wrought after a most regular pattern, so as to resemble a piece of bright green lace or open needlework. Each leaf rises from the crown on the root, like a short delicate looking fibre, pale green or yellow, gradually unfolding its feathery looking sides, and increasing its size as it spreads beneath the water. The leaves in the several stages of growth pass through almost every gradation of colour from a pale yellow to a dark olive green; becoming brown or even black before they finally decay; air bubbles of considerable size frequently appear under full formed and healthy leaves. It is scarcely possible to imagine any object of the kind more attractive and beautiful than a full-grown specimen of this plant, with its dark green leaves forming the limit of a circle two or three feet in diameter; and in the transparent water within that circle, presenting leaves in every stage of development both as to colour and size. Nor is it the least curious to notice, that these slender and fragile structures, apparently not more substantial than gossamer and flexible as a feather, still possess a tenacity and wiryness, which allows the delicate leaf to be raised by the hand to the surface without injury."

Natural objects of such graceful forms as those here described, and which abound in tropical regions, were the subjects of imitation in Eastern embroidery from the most ancient times; and needlework, if not the sister, must have been the mother of some of those kinds of fine net-work which were used as ornaments in female dress. In more modern times, and in Europe, this is known to have been the course of events; needlework lace preceded that made on the pillow.

But for many ornamental purposes the more simple method of making nets, such as were used in their every day life, would be employed in producing fringes and other large objects. The idea was so natural as to occur to any mind, above all a female one.

Making nets by the hand for fowling, hunting, and fishing, had been without doubt practised from the most ancient times. Such nets are represented on the monuments of Babylon, Nineveh, and Egypt. So universal was their use, that, literally or metaphorically, they are found as illustrations in the most ancient writings of every nation. The pages of the Old Testament furnish examples. Job says—"he is cast into a net by his own feet," "God hath compassed me with His net." There does not seem to have been any material alteration in the instrument used to produce these common articles, during the long intervening series of ages; or in the way in which the mesh was formed, knotted, and fastened.

The needle or shuttle, upon or in which the net-maker placed his supply of corded string or line, was passed just as it ever has been through the loop he had opened, and the thread was tied into a firm knot, incapable of slipping, at the exactly measured distance from the last formed one.

Almost as soon as these nets are named by any of these old authors, lace is mentioned; not only as a cord, but also as an ornamental part of dress. Lace may be described as plain or ornamented net-work, consisting of a thread or threads of flax, cotton, silk, gold, or silver; interwoven, drawn, platted, looped, or twisted so as to form a beautiful texture. Articles of female attire, depicted in paintings on the walls of Egyptian and Nubian temples and tombs, are believed to represent such net-works in looped or darned crochet, on patterned hems of garments. On one of the Egyptian pictures in the great temple of Ombos, the goddess Athos wears a head-dress resembling lace. Rosselini, in plate 41 of his great work on Egypt, shews two figures who appear to be twisting two threads, and forming what seems to be a reticulated open work. At p. 79, neck coverings are seen, but whether of twisted or drawn open net-work cannot be ascertained. But at p. 96 the ends of musical instruments are ornamented with netted tassels, each mesh having a nob or knot suspended from it. At pp. 98 and 99 are figured transparent dresses of females, ornamented seemingly

with beads, but whether on needle-work lace is uncertain. At p. 133 is a female figure whose shoulders are covered by a worked tippet of handsome appearance, the pattern of which might have been of drawn needle-work. Fringed borders were certainly applied to Egyptian articles of dress.

A lace of blue is thrice mentioned in Exodus, and was probably a fringed narrow lace or braid. Fringes are expressly named in Numbers and Deuteronomy; and *knotted* fringes became amongst that people through many ages of significant religious import. But whether the early Israelites made them of drawn needle-work for ornament, it is impossible to say with certainty. Beckman thinks these laces spoken of by Moses were merely cords or fringes of twined texture.

Needle-work and lace are much mixed up together in historic relations and descriptions. This is not surprising, seeing that all the lace produced before the middle of the 16th century, was either made by drawing the threads of fine cloth in various directions by the needle, and securing them so as to form meshes and figures composed of interstices and cloth-work, to which might be added embroidery; or by cutting the cloth ground and inserting braids of narrow breadths, woven or platted, to be used in forming figures, by being joined together at the points required by the pattern. It is possible also that the lace fringes might be made in those early times, as they have been extensively in the middle ages, by taking away the weft from the ends of cloth pieces or leaving the warp threads unwoven, and then platting them by hand into various meshes and geometric figures, leaving the loose unplatted ends of thread to form the fringe. Threads might be loosely inserted on the sides of any article, and netted and knotted in a similar way. In all this kind of work the needle and hook would be principally used.

The Greeks, in Homer's time, employed themselves not only in embroidery, for which they were famous, both as to their designs and colours, but also in fine needle-work for veils and head-dresses, and in net works. There is a marble statue of Diana at Portici, and

the goddess is represented as dressed in a purple garment edged with lace, an inch and a half broad, exactly resembling 'point' lace. The nearest approach to reticulated lace in Hope's *Costumes of the Ancients*, seems to be those figured on the borders of the dresses of Grecian females at pp. 103, 105, and 129, of vol. II.; most probably they are needle-wrought open works; and many of the patterns are so artistic and beautiful as to be worthy of study by our modern designers for manufactures. Phrygian embroidery was of surpassing excellence.

Writers who believe that reticulated lace was well known to the Greeks, assert that the custom of wearing it was introduced with other Hellenic fashions into Rome, that it soon spread over Italy as an article of female luxury, and that it became, in consequence, an important branch of Italian manufactures in the age of the Antonines.

It was customary for the earlier Christian females to wear veils during divine worship. But after the time of Titus, some Christian writers complain of the rule being evaded by ladies, vain of their charms, wearing a kind of net-work embroidered by the needle. This may probably be the origin of the modern lace veils. The Latin term 'Lacinia' dignifying a guard hem or fringes of a garment, from which our name 'lace' is derived, affords presumptive evidence that the Romans had articles of somewhat similar construction; yet netted-work like that in our military sashes was not known by them; they had no word for it. Their meshes were called 'maculae' and 'nodi.'

The practice of making the kinds of lace just described, spread over every part of Greece and Italy; the islands of the Ægean sea, Cyprus, Malta, and Sicily. It entered into Spain from the Mediterranean, and into France from Genoa, and into Germany from Venice. These two Italian cities were for many ages famous for the manufacture and exportation of their needle-work lace. Soon after the art reached the Flemings, and through them, it is thought, England. During the long middle ages of European feudalism, there was scarcely a castle where this needlework was not the

recreation of the ladies of the household; or a convent where the greater part of the inmates did not make it their lifelong and most assiduous employment. Almost all articles of dress for males and females, and especially the vestments of priests and coverings of altars, were adorned with lace of appropriate texture and designs. Sheets and pillow-cases were bordered with lace; and not seldom coverlits were themselves covered with networks of magnificent patterns and execution. Monks eagerly engaged in designing patterns for their sister recluses; in which pious recreation even Dunstan condescended to join. When the art of printing was discovered in Europe, such books of patterns were printed with the requisite instructions for lady workers in their fabrication of lace. English needle-work lace was preferred for a long time to that of the continent. A specimen of it still preserved, being the embroidered cope and manciple of St. Cuthbert in the chapter-house at Durham, is said to be beautiful beyond description. For the protection of this native industry, which was much cultivated under the Plantagenets—much fine work for the court and for tournaments being then made—acts were passed prohibiting the importation into England of laces of thread, and laces of gold, and of silk and gold, in 1483, 1 Richard III., c. 10; and again 19 Henry VII., c. 21, and 5 Elizabeth, c. 7. The importation of laces of each of these kinds, whether from Flanders, Spain, or England, into France, had become so large, that it became there also a ground of royal interference and prohibition.

Another class of needle-work lace was added to those already described. This was called *cut-work*, because the larger interstices were cut out with scissors from the muslin, and the edges secured by the darning-needle or crochet-stitch.

These various kinds of needle-work lace had reached a high degree of perfection in most European countries, when the art of making *pillow* lace was invented, about the middle of the 16th century. Some early writers asserted that it was discovered in Flanders, but by whom, and when, is not stated. After much laborious investigation bestowed by inquirers in after ages, it has

been almost universally attributed to Barbara, the wife of Christopher Uttmann; she was dwelling with her husband at the castle of St. Annaberg, on the borders of Saxony, and there invented the art in 1561.

"This is the unanimous affirmation of all annalists in that part of Saxony. And from the castle where she had taught it to the peasantry, as in a school, it soon spread amongst all the wives and daughters of the miners in that district, who found making this lace more productive than their former employment of embroidering veils according to the Italian practice, and soon supplanted them as an article of commerce." (See the *History of Annaberg*, by Paul Jenisco. Dresden, 1605.)

No traces of this mode of netting, twisting, or platting threads, drawn from spools or bobbins into lace, by passing them round pins upon a cushion, can be found used before this time, nor any terms appropriate to it; furnishing strong presumption that this was the time and place of the invention. Barbara Uttmann saw sixty-four of her children and grandchildren, and died in 1575, aged 60. That she was the true inventress is recorded on her tomb.

As an introduction to the more intricate and difficult operations necessary to the manufacture of ornamented hand lace; the art of making plain pillow lace may be thus described:

A number of threads are attached to a round pillow, each hanging down in front of the cushion, and being attached to a bobbin supplying it with thread and serving for a weight. Each pair of adjacent threads is then twisted three half turns, by throwing the bobbins over each other. The twisted threads are then severally separated, and crossed over pins stuck into the face of the cushion in a row. The like twist is then made by every pair of adjacent threads not before twisted, whence the threads become united sideways in meshes or loops. Lastly, by repeating the separation and twisting, and proceeding onwards, the plain net fabric is made of any required length.

This course of dealing with the threads on the part of the pillow lace worker in making plain reticulations or meshes, being carefully considered and well understood, will much assist the reader in comprehending the subsequent elaborate processes by which ornamented lace is produced.

To mechanise the fabrication of the plain meshes, constructing them as above described, was a wonderful effort of genius. To introduce mechanical ornamenta-

tion, has tasked to the utmost other and perhaps not less able minds. Every one of the crowd of inventors and modifiers of lace machinery have studied, with more or less assiduity, the additional methods of procedure about to be described. This cannot be more accurately done than by following the course explained in the *Encyclopædia Francaise*, article "Dentelle":

"This is a work in gold, silver, silk, or linen; made upon a cushion by the use of a great number of small bobbins, a design traced upon paper, and two sorts of pins, and which may be looked upon as a composition of gauze, weaving, and embroidery. Of embroidery, because there are many 'points' and thick threads introduced; of weaving, for there are parts where there are proper warp and weft, and where the tissue is the same as that of the weaver; of gauze, because patterns are executed upon it, and the threads which might have been considered as being warp and weft, are often withdrawn from each other by crossings. Of three things, one is necessary, in making lace on the cushion. Either to compose or make it from one's own ideas, which supposes imagination, design, taste, knowledge of many 'points,' facility of employing them, and even invention of other meshes; or, to be able to work out a pattern given on paper; or, to copy a lace already made, given for the purpose, which supposes less talent, but a perfect knowledge of the art. It is then usually necessary to copy from designs pricked carefully on vellum. The art of the 'piquer' is to discern exactly the points where the pins must be placed, in order to keep out the threads in the proper position to form the designed meshes, &c.; to ascertain by careful examination all the 'points' needful to carry out the course of working; composed as it is, of sometimes intermingled points, and sometimes points succeeding each other. If a mesh be triangular, three pins would be necessary; if quadrangular, four; and one pin must also be placed in the centre to produce the opening required.

"The work-woman by counting the threads that need to be supplied, knows exactly the number of bobbins (fuseaux), 60, 80, 100, 150, 200, &c. which will be required; and each is filled sufficiently with thread. Placing a large pin on the cushion, and having fastened the threads of as many bobbins as she can attach to this pin, so that there shall not be any thread given off unnecessarily, she places and fills a second, third, fourth, &c. in a horizontal line with the first, till all are fixed that are necessary. The pattern is then placed behind the pins. It is not difficult to learn the mode of making any sort of mesh or point, if the threads, of which it is found to be composed, be each numbered as 1, 2, 3, 4, 5, 6, 7, 8, &c., if so many are used in it. Let these numbers be invariably considered as attached to the same threads and bobbins. Think of the first that goes from left to right or right to left as No. 1, the second as No. 2, and so on. Whenever a bobbin is displaced, consider it a new arrangement of the whole. Have paper at hand and write the positions down, in order to become perfectly acquainted with them; as 4 and 4, or 8 and 8, &c. until they are well arranged in the mind and understood. Thus a knowledge of the 'points' may be quickly obtained, and the habit of

managing, arranging, and finding again the bobbins will be acquired; so that in a week all that is wonderful in the art of lace-making will disappear; at least, so the writer found it to do.

"Twisting is accomplished by passing the threads round each other so many times more or less as is desired for the mesh. First the two next to one another; then the next two; afterwards taking one of each of these and twisting it with its neighbour, before twisting elsewhere. The 'coronne' (crown, cross, or knott) is necessary to complete the mesh; and its formation closes up and ties or binds the work.

"Linen work is simply passing these threads from No. 1 to No. 3, 2 to 1, 4 to 2, and 3 to 4. There is no twist. Then leaving the two bobbins which are most to the left-hand and taking the other two that immediately follow on the left, they pass from left to right, putting 2 on 3, and going on as before. The first movement differs, the rest are the same. Then it was 1 on 3, now it is 2 on 3. Weaving or cloth work is always finished by a mesh (reseau). The method of making meshes, cloth work, &c. being understood, new designs may be easily produced, new 'points' devised and executed, and thus surprising patterns be wrought, filled with previously unknown arrangements of threads.

"The name 'dentelle' appears to have been given from the 'picot' (pearl) on the edge, arranged like *small teeth*. Differences in these points, designs, and work, distinguish the different parts and kinds of lace; as *la neige*, *le reseau*, *la bride*, *la fleur*, *point de Valenciennes*, *Mechlin*, *Alençon*, *English*, and others, which supply these beautiful and precious ornaments of female attire."

This talented French writer seems to have found it comparatively easy to follow and comprehend the intricate movements of which he gives the course and summary. It has not been so with others in their endeavours to master the various details. Perhaps those who may read these pages may find some difficulty. But all will agree that Barbara Uttmann must have been a woman possessed of an analytic mind, great genius, strong memory, and unwearied patience, to have devised and executed such a plan, capable of infinite variety in design, and perfect beauty in its execution. Still more to have successfully devoted the remainder of her life to teaching it without ostentation or reward, to the peasantry of her neighbourhood; and leaving it a legacy of ever increasing value to her country and the world, was indicative of a noble and benevolent heart. Her memory is yet revered around St. Annaberg for her skill and patriotism; and will continue to be honoured as the inventress and foundress of a manufacture so justly prized and admired.

It is probable that in the first instance a series of

plain meshes only was produced, and used as a ground for the application of ornamental work by the needle or hook, with which work many around were practically acquainted. But it is certain that before long cloth work, open work, thick threading, and other things necessary to give effect to a pattern, were introduced in the manner now universally employed in making pillow goods. This new mode of making lace speedily became known over the north of Europe; and the articles thus made came into so large a demand as to require many women to be taught the art. In Flanders the manufacture soon becoming thoroughly established, very large schools for children to learn lace making were set up; and in these, excellent goods both in design and execution have ever since been made in large quantities. Brussels, Malines, Antwerp, Bruges, Valenciennes, and Ghent have been, and continue to be, justly celebrated for the variety and beauty of their respective kinds of lace. From some of these places articles were shewn in the recent International Exhibitions of almost priceless value.

The French applied themselves early to this manufacture; and Colbert in 1666 obtained the royal sanction to measures for its thorough settlement in Paris and the provinces. The Count de Nassau brought his nurse Dumont from Brussels; and as she perfectly understood lace making upon the pillow, he obtained for her the sole privilege of manufacturing the article. She taught more than 200 young women, many of them of good families, who soon made lace equal in quality to that imported. From thence the business spread almost throughout France. Of its variety, extent, and importance in value of products and numbers employed, an admirable account was given by M. Aubry, in his report to the International Jury, in 1851, upon the lace trade of France.

It is said this manufacture came to England from Flanders by the instrumentality of refugees who settled at Chalfont in Bedfordshire. This is uncertain; but not so, that we owe much to the endeavours made here to imitate the excellences of Flemish lace—the superiority of which still remains incontestible. In this, as in other

countries, it was thought necessary to teach children at too early an age. A school was set up for this purpose at Great Marlow in 1626; and about 1650 the cushion lace trade was flourishing in Buckinghamshire, from whence it extended into Northamptonshire. At Honiton there was early established the production of flowers and sprigs, in imitation of the bouquets and floral ornamentation common in one class of rich Brussels lace, and which were usually sewn upon a plain net of three-twist or platted ground. Shawls of this kind were sold for from twenty to one hundred guineas. These sprigs whether of Brussels or Honiton make are now ordinarily applied to a three-twist net wrought on the machine.

The earliest pillow lace made in this country, as shewn in the portraits painted by Vandyke, Lely, and Kneller, was Brussels 'point,' the net-work made of thread drawn off *bone* bobbins (the origin of the English name bone lace) upon the pillow; the pattern and sprigs embroidered by the needle. This was superseded about 1730 by the *Old Mechlin* ground and wire ground, both of which were very durable and of rich artistic designs. The *Trolly* ground came into fashion about 1750, wrought in coarse angular and ugly figures of the most vulgar taste possible. The re-introduction of the *Old French* ground, nearly the most ancient known, was a happy change; and it remained in partial use for about seventy years.

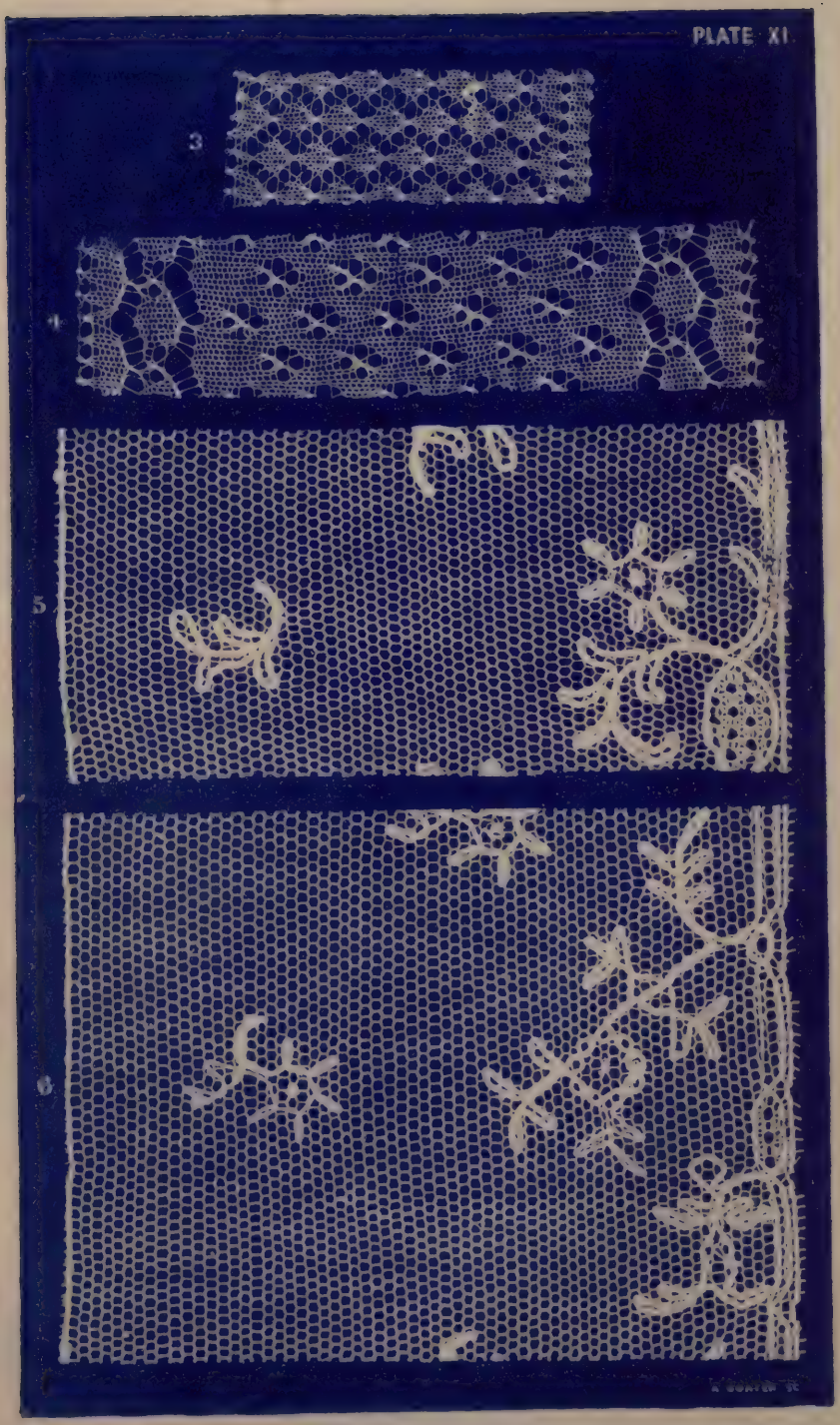
In 1777-8 a new article in the 'point' ground was brought from the Netherlands. From its first appearance may be dated the origin of the modern English pillow lace trade. The peculiar construction of the ground renders the article light and elegant. For the first twenty-five years the patterns of the English 'point' goods were poor and spiritless. Between 1800 and 1812 a change to a freer and bolder style took place, and the improvement and increase of the manufacture was unprecedented. The entire English cushion lace trade had so far extended in 1800 as to employ at least 150,000 hands. In 1830 it was stated by petition to Queen Adelaide that 120,000 persons were dependent upon the business. The numbers employed in France and Belgium, in making cushion lace, had been very

greatly reduced by revolution and war; in England by change of fashion, and in some degree by competition with machine made 'point' and 'warp' goods. But both here and on the continent a reaction has steadily set in; so that there are at present more persons employed in making pillow lace than at any former period of its history. With this increasing demand for the best hand made lace generally, special search has been carried on for *old* hand made lace of every kind. Thus a curious practice has arisen latterly. It had been the custom in some places on the coasts and in the islands of the Mediterranean in past ages, for the rich bridal lace robes and veils never to be re-worn, until the corpse of her who once before was adorned by them was re-clothed in them preparatory to her interment. Vaults have been rifled, and these precious and often magnificent articles, so eagerly sought after in the markets of Brussels, Paris, and London, have been brought into the hands of dealers, who know how to appreciate their worth, and, through them, add for ages to the charms of living beauty.

Whether regard be paid to the intricacy and delicacy of the work, the numbers employed upon it, its varied and extraordinary excellence, and ultimate commercial value, the subject of hand wrought lace is of great interest. A perusal of Mrs. Bury Palliser's splendid and exhaustive volume is conclusive upon this. The illustrative plates given by her are invaluable.

It has been thought necessary to enter thus far into the history of the manufacture of lace by hand, inasmuch as it is to imitate the productions of its fullest and last developement by the cushion, both in its meshes and ornamentation of the ground, that the thoughts and efforts of mechanical lace makers have been directed for the past half century.

PLATE XI



CHAPTER IX.

LACE MAKING ON THE STOCKING-FRAME.

It is now necessary to trace the course whereby the productions of the intricate manual art described in the last chapter have been successfully imitated. Nearly every known mesh, certainly every useful one, has been mechanically produced, and into most of them elaborate and tasteful designs have been introduced, so that the articles made on the machine are often distinguished with difficulty from those made by hand. This has been necessarily a slow process and a very costly one. It was exactly a century ago, 1760 to 1770, that Crane, Else, and Harvey in London, Hammond, John Lindley, sen., Holmes, Robert Frost, in Nottingham, were engaged in efforts to make lace net upon the stocking-frame, as well as the fancy hosiery already described. These attempts were for a long time confined to this machine, seeking by alteration of its arrangements and suitable additions to it, to obtain the desired results. So far as plain nets were in question, they were in due time successful in producing *looped* articles of perfect regularity, and so highly appreciated as to lay the foundation for the present machine wrought lace manufacture, whether domestic or foreign. It was reserved for a much later epoch to witness the production by machinery of a net composed of twisted meshes like that from the pillow.

The twilling machine before named was amongst the first which were subjected to modifications for the purpose of obtaining different meshes and kinds of net. The interval between 1770 and 1780 was distinguished for experiments in the leisure hours of workmen at the fancy stocking-frame, in forming meshes by hand, which led eventually to many discoveries in the mode of

making them mechanically. Some of these newly invented kinds of lace at once took a position in the market, and for several years gave considerable employment to hands and machinery. In these the tickler-machine was made the chief instrument for the removal of loops and consequent formation of meshes. The '*spoon* tickler,' covering two needles and delivering the stitch on both, was probably invented by John Lindley, sen., and introduced by Thomas Taylor, a framesmith of Nottingham.

Hammond, who had added 'dogs' to this machine, was one of these workmen conversant with the meshing art, but who had so little application and self-government, as to render his knowledge of very uncertain practical use. Both himself and his wife were of intemperate habits. On one occasion in 1768, being together at a public-house in Nottingham without money, credit, or regular employment, Hammond cast his eye on the broad lace border of his wife's cap and a lace caul, and thought he could imitate the fabric. Having borrowed some silk, he went to work upon his frame at his home in the Rookery, and produced a net which with the assistance of his wife was made into caps having somewhat the appearance of lace, which he sold quickly. He called the article, though without any actual resemblance, '*Valenciennes* Lace.'

This net was produced by using a tickler to every other needle, and removing every other loop to the next needle but one; and the remaining loop to the second needle the other way in the next course. This was technically called 'cross stitch,' or 'wire ground *Brussels*.' He afterwards removed both stitches to the left two needles, and next course both stitches two needles to the right, thus forming what he termed 'double cross-stitch Valenciennes.'

On this mode of operating by the added machine, nets suitable for mitts, gloves, and purses were made. But it is difficult if not impossible to understand how anything beyond a net web of interstices formed with four irregular sides could be thus produced. It is certain that this was a step towards making looped lace net. But equally so, that to ascribe to Hammond, as is popularly done, the honour of producing by machine an imitation of cushion lace and of making Bobbin net, is

incorrect. His net was without a single characteristic of these articles. He was probably the first to make a net from the stocking-frame, though that is not quite certain.

His production was however very saleable, and he obtained by making it a precarious income, only labouring at irregular intervals, to supply the most pressing necessities, "working by day, and drinking by night; thus passed several years of the life of this original machine wrought lace manufacturer."

This year 1768 was also remarkable for the application of a kind of warp frame to the stocking-machine by Crane of Edmonton, where may be traced the origin of the warp machine, to which a subsequent chapter will be devoted. Also for the construction by Else and Harvey of the pin-machine, elsewhere referred to, upon the transmission of which to Nottingham in about 1770, a further important advance was made in the manufacture of lace net, and consequent employment of capital and labour there.

Each of these kinds of net it must be borne in mind were made by the looping of one continuous thread formed into meshes across the machine, and therefore liable on being broken to unrove, moreover at first the size of the mesh was irregular.

The meshes of cushion lace have three to six *equal* sides, usually the latter, and to exactly imitate such nets by machinery, was the object of much thought and effort.

An article called '*two plain* net' was made, by using one tickler for every third needle, leaving two needles plain in every course. Of the three stitches, one was removed to the second needle on the left, and of the two stitches remaining unmoved, in the next course the stitch was taken from the right-hand needle and delivered two needles to the right, upon the needle on which the former stitch had been placed. Thus a kind of hexagon mesh was produced. By moving a rack handle the loops could be removed at will, and patterns would be the result.

Shortly after some unknown person devised a great improvement by so removing some of the stitches as to leave large interstices like the open works in real lace. These have acquired the name of 'bullet holes'; and inasmuch as 'eyelet hole' hose had been subjected to embroidery, that obvious improvement was soon added by surrounding these large interstices with needlework.

This was the humble beginning of the vast business of lace *running*, in which, through subsequent lengthened periods, 150,000 females were employed in ornamenting lace net of various kinds as they successively appeared and flourished.

A stocking-maker, named Holmes, with the assistance of Mr. Robert Frost, invented this 'two plain' plan. The former was evidently an ingenious man, but died poor. The method was used from 1777; in 1790 there were more than 200 frames on with it; in 1817 one Wightman was the only person making it. It was carried into France, Spain, Italy, and Germany, and many frames were employed upon it abroad. Some have believed that *this* was the first lace-making-frame that was ever arranged.

The Robert Frost above spoken of, obtained in 1777 a patent for making an article called 'square net,' upon a machine whose arrangements and principal movements are founded on the Derby rib frame.

The net is formed by the use of the tuck presser and knotted points. In its first operation, the web was made having one needle looped and one not looped. The loop was knotted by being placed on the next needle on each side. In the next course the looping and knotting were reversed; the tuck being on the needle before looped. There was a further bar fixed to the added knotting-machine, having only a point to every other needle. It had an additional bar also to which horns were affixed. The point bar moved to and fro, so that the points might be applied to this or that needle without affecting the horns. The pressed stitches were then knotted on the unpressed ones both ways, the machine being used twice every course for that purpose. Thus by varying the presser and points one needle every course, square fast meshes were produced.

This net was very lustrous and durable; so that it was well adapted for mitts, gloves, purses, shawls, &c. Indeed it was strong enough to be used for the foundation of wigs. But it was costly in proportion. Not more than forty machines were employed in making it, and it is now almost forgotten. Attempts to make square net on knotted frames did not succeed till 1798.

According to Henson, the last person who made work on one of these frames was a frame-work-knitter in Spitalfields, who about 1834 produced square net for Mr. Thompson, of Phœnix street, London. The latter was called the father of all stocking-makers; for his

ancestor had been a journeyman to Mr. Lee, the inventor of the frame.

It may here be mentioned, that long after in 1808, a great improvement was made in the tuck presser by casting stumps with grooved ends into broad leads screwed on a moving slide on the presser. They acted as teeth in the pressing slide, and thus worked more safely.

'Flowered net' was obtained by leaving some parts plain in the shape of flowers, &c.

The ticklers were not cast into leads: but were made from thick wire beaten out broad at the bottom end, where, through a hole a wire was passed lengthwise like a spindle on to the tickler bar, and they were acted upon by a lever motion. Where the patterns required plain work, the ticklers which would have there acted were turned upwards by a roller, on which the patterns were set like tunes on an organ barrel.

This was said to be also the invention of Mr. Robert Frost.

'Spider net' was of a very slight texture, in which the figure of that insect or any other figure might be wrought. It continued in use but a few years, and no description of the machine on which it was made has survived it.

From the specific character, which may be easily traced through the various modifications applied to the machine added to the stocking-frame, and its modes of operation, it was almost inevitable that ingenuity applied by many minds should, even without concert, be successfully directed to some plan, whereby not only a perfectly regular six-sided mesh should be produced, but one so constructed as to be sound and durable as well as beautiful. This was accomplished by the construction of what became known as the 'point net' machine.

In this invention both Strutt's machine and Betts' modification of it were used: the top arms were moved from side to side; instead of machine needles perpendicularly acting between the frame needles, a new series of instruments were placed on the machine needle-bar, equal in number to the needles in the frame-bar. Each was in the form of a barleycorn, with its long blade (or point); the underside was made flat, and had two eyes to fit on the heads of two needles. The blades of these points or ticklers were thin enough to pass between the needles. The work was performed principally by two

operations. By the first, the thread passing round two loops made a series of arches; by the second, on the thread being removed from the base of these arches, another higher series of arches was made; and when the work quitted the needles, both series of arches took a straight line, and regular six-sided meshes were formed, which, when the net was stiffened, were equal in beauty to the meshes of *real* plain net. When wet or even damp, this net, however, as first made, shrunk into a fabric looking like crape.

The manner in which this mesh was first made, not constituting it a sound article, but one that, if the thread were broken, would cause the net to unloop and run into a hole, a *fast* stitch was effected by pressing the loops and forcing them over the needle-heads repeatedly through several intricate movements too difficult for description.

The manufacture of point net contributed more than any other to the prosperity of the trade of Nottingham up to 1815, when it gave place to the then lately established twist bobbin-net manufacture. There were various competitors for the honour of its discovery; it is probable all who are most frequently mentioned as experimenting at that time, may have contributed their share towards it. One Flint, a Nottingham journeyman stocking-maker, conceived the idea how this net could be made. His necessities so pressed upon him, that he sold the invention to Thomas Taylor the framesmith, his neighbour, for £20, who, with his son, was a good workman, and perfectly able to work out Flint's instructions, and add ideas of their own. Still they seem not to have been in a position to perfect the machine, and called in Morris, who completed the movements so as to turn off from the machine the single press article. His only reward, Blackner says, "was the satisfaction of an honourable mind, of having added to the stock of human benefits." Though some have asserted that Flint obtained the plan from John Lindley, his contemporaries generally agree that Flint was the real inventor; and his subsequent misfortunes and death in the poor house of St. Mary in Nottingham were the more deplored, seeing that he had so greatly benefitted the trade and town by the important invention of the 'point net' machine.

Taylor took out a patent in 1778, No. 1192, for this

invention; and sold it to Morris, the patentee of the eyelet-hole machine. The reason was assigned, but in error, that Taylor was afraid of infringing Strutt's patent. It is more likely that though the net was of unexampled regularity and beauty, its light texture and unsound make of mesh retarded its use. At length in 1786, John Rogers, of Mansfield, produced the double pressed fast point net of solid texture.

This Mr. Morris, to whom Taylor had sold his patent, soon after disposed of his entire manufacturing business to Messrs. John, Wm. and Thos. Hayne, of Ashbourne and Nottingham; and attached so little importance to the invention under notice, as to make a present of it to his successors. They, on looking into it, saw that it gave them a perfect mesh as to shape, and only needed the additional operations of Rogers just referred to, and a fast net would be secured, which might be cut in any direction without deranging or setting the loops at liberty. This was at once an ample reward for the perseverance and talent bestowed in perfecting the modification, as there was only entailed a loss by using it of one-third in the amount of the production, with a far larger addition to its value. Up to this time there were not more than 50 point frames, and those only twenty inches wide, in existence. The demand doubled yearly, until, in 1810, there were at least 1500 to 1800 employed in Nottingham, many of them thirty inches in width. These gave employment on the spot to 15,000 men, women, and children; besides some tens of thousands throughout the neighbouring counties, who were engaged in needle running and tambouring this net. Mr. Wm. Hayne first introduced the *splitting* of the *stitch*, instead of carrying the needle over and under the threads of the web. This gentleman had considerable abilities, of which he was vain. He often said, holding up his hands, "remember these fingers first run lace"; that is, first *rightly* embroidered it. His plan gave it a flattened smooth surface and increased effect.

These embroidered goods were from one inch to thirty inches in width of edgings, insertions, borderings, flouncings; also veils, scarfs, and every description of

articles suited to the varying fashions of the time. The principal point net manufacturers were W. and T. Hayne; Maltby and Brewitt; Wilson, Burnside, and Watson; and Robert and Thomas Frost.

Mr. Robert Frost sought to make point net by using a double row of pins, in place of Flint or Taylor's barleycorn points. The Messrs. Haynes proceeded to a trial against him at Nottingham, and gained a verdict. But from Frost still expressing a determination to get the patent set aside, on the ground that it had been improperly obtained, a compromise was entered into.

Mr. Thomas Frost, a brother of Robert, devised an ingenious but complex machine for making figured net of various kinds: partly formed of stocking loops, and partly of six-sided point net. He used his brother's cylinder tickler machine for looping and making lace when required, with additional length of thread. It produced a loose fabric, and therefore was little used.

Messrs. Haynes afterwards brought an action against Mr. Thomas Maltby. This person, who was of a respectable family at Hoveringham, near Nottingham, had for some time wrought in the stocking-frame; and his family furnished him with money to pursue the point net manufacture on a respectable scale. Upon Haynes attacking him as an infringer, it was found that Taylor had never enrolled his specification. Maltby therefore obtained a verdict setting aside the patent.

In consequence of the falling off of demand and to cheapen the article, it was made again of single press in 1811; and still further to lessen the cost of cotton point-net, single yarn was used. This completed the ruin of the manufacture in England. By 1815 the demand had entirely ceased here. Some machines had been wilfully destroyed on which the slight goods were made. Many others were taken from time to time to Leicester, where worsted webs of fine quality were made upon them. The last twenty-eight point lace frames ceased working and were sold in 1828. Six only of the workmen are now living; so that were there not a series still existing of patterns produced in this, for a long period, most important branch of the trade of Nottingham, the machines and their products with those

who employed and worked them, would very soon be all passed away. A point-net frame could not now be found, if one were desired, to be placed in a local museum of extinct machinery.

The author has had the opportunity of lately inspecting four such large pattern books filled with examples of white cotton, white silk, and black silk run and tambour worked lace, in about equal proportions. They are supposed to be of the manufacture carried on by the Haynes, and contain 11,930 specimens dating from 1797, presenting curious and very striking contrasts in regard to style and taste with the designs of the present day, though the net ground is as regular and perfect as machinery or hand has ever produced. There are rose trees with stems as straight and bare as a hop-pole, flowers without a curved line in them, perfect triangles; masses of cloth work with hideous Hindoo or Chinese configurations, without the slightest approach to a flowing line in leaf or bud or stalk. In a word, they prove the absence of all knowledge of the art of design in the machine lace trade of that time, although the amount of work put in never was greater, nor on the whole more conscientiously performed. On the side of taste the present lace manufacturers of Nottingham immeasurably surpass their predecessors of fifty years ago. Another later set of patterns worked on the same grounds, are of gradually improving forms and taste. They are believed to have been Maltby's, consisting of 5000 specimens; one volume of 2000 patterns, supposed to be Wilson's, contains some which are better still. These volumes, containing altogether about 22000 patterns, are preserved for reference at the School of Art, People's Hall, and Mechanic's Institute. Large and useful additions may be expected to be made to this collection from time to time.

In the *Society of Arts Transactions*, 1796, vol. XIV. p. 273, is a drawing with a minute description of a fishing-net machine constructed by Mr. J. W. Boswell, for which he received the Society's award of fifty guineas. The inventor knew the stocking-frame, and March's attempt to improve it. He uses beam, comb, sley, jacks and hooks, and produced by the use of a single thread

placed on a netting needle passing from side to side of the machine, a web of sixty-eight meshes across and eight feet wide, when stretched out. The piece presented to the Society was thirty yards long.

Loops were made after the manner of those on a stocking-frame; these being much enlarged, a thread was drawn through them by a hooked long wire, and thus formed a fast square net. The corners of each mesh consisted of the true fisherman's knot. The selvages also were perfect.

The mechanical construction of the machine is ingenious, though, judging from the description, complicated. It is creditable to the inventor's talent. It is said that there are some of these frames still at work in Scotland, but owing to the fishermen making their nets in their leisure time, the use of these machine wrought nets seems never to have become general. In his letter to the Society, 7th December, 1795, Boswell says, "I hope soon to present a sample of exceedingly fine net in imitation of lace, made on a finer machine which I have now nearly ready for working. The invention is equally curious and novel, and may be of great utility to this country in diminishing the large sums that annually leave it for the importation of lace."

No further reference to this fine net lace machine appears in the subsequent volumes of the Society's Transactions. The Author had a lengthened intercourse with Boswell while they were travelling together on the continent in 1824-5, and if such a machine had been perfected, the fact would certainly have transpired, when references were made by him to the one above first described. Mr. Boswell complained with bitterness of the neglect with which the world treated his inventive talents.

This was the last important modification of the stocking-frame made in the eighteenth century, and one of those in which a near approach was made to the manufacture by machinery of a sound net-work. On this account, as well as because its parts and construction have since been referred to in several important patent discussions, it is worthy of the notice of studious mechanics.

CHAPTER X.

THE WARP HOSIERY AND LACE MACHINE.

A VERY important step in developing the hosiery and lace manufactures took place about 1775, by the construction of what is known as the "warp" machine, from the addition of the warp threads of the old weaving loom, for the purpose of forming upon them the looped stitches of the stocking-frame. The competitors for the honour of this invention were Tarratt of Nottingham; March, one of the knotted patentees; Crane of Edmonton; Morris of Nottingham, according to Blackner; together with, Henson says, Vandyke a Dutchman. Morris told Blackner that Crane was the inventor, and not being overburdened with money, imparted the discovery to March, who gave him one hundred guineas for the privilege of using it as his own. March, at the instance of Horton, visiting Nottingham to obtain superior workmen, Morris got from him some insight into the plan, and being an expert mechanic, began to construct a warp-frame. The credit of March was by this put at stake with Horton, and a doubt arose whether a patent could be obtained. At an interview between Horton, March, and Morris, the former, after hearing the statement of the others, came to the conclusion that neither had any claim to the invention, but that it belonged to Crane. This account Morris was candid enough to give to Blackner many years afterwards.

Crane had constructed his warp-frame in 1775. A thread was given in it to every needle. On it silk hose having blue and white zig-zag stripes were made. Some have asserted that the name by which these party-coloured hose with their peculiar shaped stripes were known, "Vandyke warps," arose from fancied resemblance to the pointed angular ruffs in the pictures

of the celebrated painter of portraits. But Henson says:

"The London stocking-makers give a far different account of the invention of the warp-frame, and which most probably led Mr. Farey the engineer, in his evidence to the Commons on the patent laws, to fall into the error of stating that the stocking-frame itself was originally a foreign invention. They assert that the discovery was made in Holland, by Vandyke, a Dutch gentleman. He despairing of remuneration at home, came to London and applied to the knotted patentees, Horton and March, who closed with his proposals and entered into partnership with him. March had certainly a partner of that name in his business at Moorfields, and the articles were known as Vandyke warps."

This machine, whose powers of varied production far exceed those of the old weaving-loom, the stocking-frame, the bobbin net machine, or any other tissue making machinery hitherto constructed, was exceedingly simple in its first arrangement as an appendage to the stocking-frame. Henson believed that he was shewn the first warp stocking-frame in the pigeon-loft of Mr. Hardy in Twister's Alley, London, and thus describes it:

"The star boxes and falling bar were taken away from the common stocking-frame, and the lockers were fastened to prevent the jacks from falling. A series of guides, of the same number and guage as the needles of the frame, with holes in their ends, were fixed on a bar near the heads of the needles. At the top was a warp beam furnished with as many threads as there were needles, and a machine to guide these warp threads to the needles, each passing through its guide. A part of the machine was adapted to make each thread to form a loop like that which school boys make on a string. This alone would have produced only a series of looped strings. But by other movements a spring was applied, and the guides were removed one needle to the right or left at pleasure; and by the same movements being repeated in looping, the two next and every next loop was conjoined to its fellow loop. By removing the guides two or more needles to the right, and then working the same number of courses to the left, a knitted web was produced of zig-zag angular texture, and varied coloured stripes could be made."

The web was non-elastic, was cut by scissors, and sown up into the shape of hose; and being put on and taken off the leg with difficulty, the unsightly seam was liable to break. These stockings did not retain hold of the English market. Made of cotton yarn, they were in considerable demand for Germany, so that three hundred frames were employed. The pieces replaced much of the knotted work.

There is considerable probability that the origin of this ingenious machine is due, in point of fact, to the versatile mechanical genius of Mr. James Tarratt, then well known to the constructive world of Nottingham and the hosiers of London. This idea has always prevailed to a large extent, but the facts cannot be ascertained. It is rendered the more likely, from Tarratt having in 1785 applied treddles to the frame to effect its various additional movements; also building the machines forty-four instead of sixteen inches in width, thus trebling the width and doubling the speed by his improvements.

In 1792, Roland, of Nottingham, produced a modification of, and addition to, the stocking-frame which was patented by Mr. Robert Barber, of Bilborough, No. 1923, as "a method of making it capable of using hard materials in double looped frame-work." In 1797 he took out No. 2175 for a further improvement; and in 1805, No. 2858, for making "stocking stitch warp work." The articles made under these patents were as heavy as blankets, and large contracts were entered into from time to time with the government, for the supply of woollen jackets and trowsers. Our sailors fought for years clothed in Nottingham manufactures, for the supply of which 500 machines were employed, made from fine frames and of good materials; this webbing formed an excellent article for gentlemen's pantaloons.

In 1796 Brown and Pindar arranged a warp hosiery frame, in which the needles were placed upright instead of in the usual horizontal position. One hundred and twenty such frames were employed, and afforded the extraordinary wages of 50*s.* a week to the workmen.

The Berlin or Buonaparte warp piece web was introduced in 1799 by Roland. Copestake also claimed the invention. A large amount of these goods was made, but not being a sound article, they went entirely out of use in a few years.

Thus the warp frame was found capable of competing in the woollen and cotton cloth markets with the common loom, and with a variety in its productions beyond its rival at that and even up to the present time. Indeed it is impossible to describe all the methods and

uses of this frame; no other machine is so universally applicable. Every kind of thread may be used: silk, cotton, linen, and animal wool. Its speed is also unequalled, as it loses no time in passing weft threads; only one gait or thread to the next is required, each thread being looped through a steel guide to its neighbour; all the series thus operating together across the loom. The cloth when made will not tear out, it must be cut. Velvet has been made on warp machines 150 inches wide, without using wires for raising the pile.

The number of warp machines making cloth in the early part of this century was very large in England. Its great usefulness and rapid power of varied production caused it to be used abroad extensively, it having found its way into France, Spain, Italy, and Germany.

But the substitution of a warp thread to every needle, instead of confining the whole set of needles to successive loopings upon one thread, it was soon discovered had introduced great facilities for varying the meshes which might be made on the warp machine. Accordingly, attempts to get an open work article of lacy appearance from it were made about 1795. These were attended with considerable success. At the beginning of the present century, improvements were brought forward in the use of the machine, by which it was adapted for the manufacture of not only plain, but figured lace. Further modifications have simplified the mechanical arrangements so much as to greatly facilitate changes in the articles produced by it. To the heaviest cloths for warmth was rapidly added the fabrication of the lightest gossamer silk net lace; silk blonds and edgings; cotton tattings and pearls; antimacassars and d'oyleys of durable qualities and effective designs, thick threaded, pearled, and finished in the loom: these all now form classes of goods of very large home consumption, and enter equally into our export trade. The low prices at which they can be sold, combined with the durability of the heavier kinds of cotton warp articles, have made them the sure pioneers of our trade for more expensive lace goods in parts of the world where otherwise but little lace would go.

In 1810 the number of warp lace frames at work

was 435, according to the workmen's books. They were employed in making so-called *Mechlin* net, but it was of inferior quality. Nevertheless it was made of cotton yarn specially prepared for this purpose, costing fifteen guineas per lb.; and the workmen engaged in making the net obtained weekly wages of four guineas for a time. The use of this article assisted in the downfall of the point net trade. The persons who devised this modification were Copestake, of Ilkiston, and Brown, of Nottingham.

In 1804 an upright warp machine was set to work, in which no sinkers were used. The invention was claimed respectively by Robert Brown, of Nottingham; James Ewing, travelling with a waxwork exhibition; and James Tarratt, whose name so often appears in these annals of inventive ingenuity, and who, after many years of active employment of his talents upon every kind of hosiery and lace frames, finished his useful life in honourable retirement at the Charterhouse in London.

Hitherto the varied movements required in the warp machine had been made by hand. The way in which rotary power could be applied, requires a notice of the talented inventor. This was Wm. Dawson, who, though a Leicester frame-work-knitter only, made a great discovery in mechanics.

This was by his devising a wheel irregularly notched on its edge, and which, when revolving, operates upon horizontal bolts or bars that are pressed by springs on their edges. As the bars are pushed from it, or allowed to approach, a figure is wrought by this lateral motion in the stuff which is being made.

This plan is used in nearly every kind of weaving machinery; its useful qualities are continually developing themselves, and being everywhere known as "Dawson's wheels," serve to perpetuate the name of the unhappy inventor.

In 1791 Dawson patented (No. 1820) "a machine for making all kinds of hosiery," but it was more especially adapted for military sashes (which from the then existing war were in great demand) of crimson silk for the commissioned, and worsted for the non-commissioned officers. Unexpectedly to the inventor, he

found the machine could be altered to plait stay laces with great rapidity. Being a general mechanic, he planned means for tagging them, cutting the tin and closing it in one operation. Two Leicester manufacturers assisted with means, allowing him a guinea a-week; but not completing his design in the time expected, they withdrew their support. He then found a friend in Mr. Gregory, an architect of Nottingham, and obtained the patent, working a number of his machines in Turncalf Alley, Nottingham. Like many geniuses, he squandered away his money; and at the expiration of his patent, he besought Lord Chancellor Eldon to have it renewed. He removed his machinery and business to Islington, London, and there made a small and beautiful model, which his lordship inspected and worked. But the privilege was not extended, and the unhappy applicant destroyed himself in consequence.

It will be observed that these elevations and depressions upon the outer surface of a wheel, thereby becoming eccentric in its revolving operations upon bars, would be the same in principle as those of the catches of the barrel of an organ for the opening and closing of its pipes; and, of the Jacquard apparatus, by its perforated cards on the threads of a weaving-loom, or on the bars and threads of a lace machine.

In subsequent descriptions of various machines it will be seen that, according to the more simple or complex character of the meshes and ornamental character of the fabric to be produced, one or other and sometimes two of these systems combined, have been brought into play in lace manufactures. The organ barrel had been in use twenty years, and Dawson's wheels ten years, in several kinds of Nottingham machinery, before the Jacquard apparatus had been introduced into notice at Paris and Lyons in 1801.

Dawson's unequal surface wheels were applied to the warp lace frame in 1807, and have been ever since used. Mr. Simon Orgill, of Castle Donington, was mainly instrumental in effecting this great improvement. The same year, 1807, the spotting bar and wheels were applied by Vickers and Gray, both of Nottingham. And in 1809, Kirkland, of Beeston, by adding

other wheels and a further alteration of the frame, produced 'two-course' silk net.

At this point the warp lace trade came under the direct, and afterwards frequently recurring, influence of close competition with bobbin twist net, for the manufacture of which Heathcoat's patent was taken out in 1809. In some respects it would seem preferable to relate their respective alternations in the same narrative, and as they occurred; but clearness and brevity seem to require that the account of the warp manufacture should be a continuous one. To resume, therefore,—Daycock and George Morrison in 1811 put wheels and dividing bars into the warp frame, so as to make upon it *silk blonde*. This article became a considerable branch of the lace manufacture, at intervals, for the next forty years; and, in making the net, workmen gained for some time £10 a-week wages. Mr. Robert Frost assisted in developing this improvement.

In 1816 warp pearling was introduced by Wm. Fowkes, of Leicester, and Kirkman, of Nottingham. This article is much used, and is of great importance to the trade.

In 1819 warp Mechlin had disappeared; and not long after the two-course and blonde declined till about 1830, in consequence mainly of the superiority of the French mode of dressing their light silk nets.

The *plain* warp nets, which had been largely made for ten or fifteen years, were thus rapidly driven out of use by the superior texture in soundness and appearance of 'twist' net. This caused many of the oldest amongst the warp frames to be broken up and sold as scrap iron. But it had the immediate effect also of directing the attention of mechanicians to devise the means for ornamenting the lace in process of manufacture.

After an effort to rival bobbin net by a new net, called *mock-twist*, bullet hole and spotted warp nets were the first additions made to the plain articles, and these were produced by Copestake, Boot, Roberts, and Herbert.

There sprung from these, *warp-tattings* in 1822, the wheels for producing which were devised by Copestake, of Stapleford, and Read, of Radford. These articles are now consumed to a larger amount than formerly.

At their first introduction the demand was such as to greatly raise the value of the existing machinery and to cause new ones to be built.

William Hardy, of Nottingham, devised a machine, in 1824, for spotting and figuring the imitation twist net above named.

In 1831 the warp production, under the patronage of the court, became very large, and the trade attained a state of great prosperity. Queen Adelaide appeared at one of her balls in a dress of white silk lace of Nottingham manufacture.

Many rotary machines, of 100 to 150 inches in width, were built to meet the increased demand, which lasted till 1835, when, in consequence of the bobbin net machinery being further adapted to make ornamented lace of a superior character, cotton warp tattings were much depressed for a time, as was also warp silk blonde, for Heathcoat's white silk twist net took its place.

In 1833 William Herbert took out patent, No. 6399, for tattings in imitation of bobbin net; in 1835, Streets and Whitely, No. 6748, and the same year Dunnington and Copestake, No. 6833, both for improvements in warp frames.

The warp machinery was turned upon gimps, lace mitts, and gloves, from 1836 to 1846; articles which have gone nearly out of use.

In 1838 the commercial panic seriously affected the warp trade, and the narrow tatting-frame workmen were reduced thirty per cent. in their wages, affecting 650 hands. Those employed by Mr. William Herbert, turned out for an advance, which was not obtained. The wide machine hands were then earning 40*s.* a-week generally. Draper applied the Jacquard to the warp frame in 1839. By this means articles of elaborate design, as shawls, scarfs, falls, laces, &c. were brought out, to be supplanted again in due time by their rivals from the bobbin net machine.

An impression from a cotton warp lace selling in country shops at 1*d.* per yard, is given as a specimen of combined excellence and cheapness. It will be found in Plate XIV.

Since 1839, other kinds of webbing have been produced from the warp looms.

Mr. Henry Dunington made elastic woollen cloth for gloves, and for some time the best of its kind. This mechanician had patented in 1836, No. 7132; and in 1838, No. 7801; and again in 1838, No. 7828; in 1839, No. 8035, and No. 8292—all for improvements in warp hosiery machinery and fabrics.

In 1849 he took out No. 12561 for his still further improved method of making hat-bands and gloves. To this manufacturer the trade owes an important advance in the fabrication and use of warp articles, on which he has bestowed much time and money.

In 1845, Dunnicliff and Dexter took out a patent, No. 11020, for making velvet pile ornamentation wrought in warp lace.

In 1849, Ball and Dunnicliff, and also Haimes and Hancock, each produced piece velvet from the warp frame, suitable for gloves. The former house made velvet in combination with lace, the one fabric being the ground, the other forming the pattern introduced into it. An impression of one of these velvet laces is given in Plate XVII.

As a striking example of the progress of this class of machinery, it may be stated, that the average width of warp blonde machines was 54 inches in 1830, and the production 80 racks, or 50 square yards per week. But Messrs. Ball, of Ilkeston and Nottingham, placed in the Exhibition of 1851, a *power* warp machine, which if worked twelve hours a day would produce 800 racks, equal to 1200 square yards in a week, or 60,000 square yards in a year. A square yard of silk blonde sold in 1830 for 2*s.* and in 1851 had become reduced to 6*d.*

The warp frame has amply rewarded those who have thoroughly understood and judiciously employed its diversified capacity for production. Amongst these no one was more conspicuous than Mr. William Herbert, who was the son of a frame-work-knitter, and himself worked as a youth in the stocking-frame. Enlisting into the army, he served in the Netherlands, and was one of the foremost at the storming of Bergen-op-Zoom. He escaped without harm, and quitted the service at

the close of the war in 1815. On returning to New Basford, he learnt to work a warp machine. The savings he then realized from high wages enabled him to get an interest in a machine, on which he made tattings, laying very soon the foundation for a business which he carried on eventually at Tottenham. The profits that he then made were large, but adverse times supervened, and they were dissipated. Mr. Herbert then produced cords and braidings from the warp frames, and gained £50 a week from a single one of 120 breadths. These were disposed of at Coventry, where the demand for a time was so great as to exceed his power of supply. He again accumulated a large sum of money, and increased his machinery so as to overpass demand, and stocked the articles extensively; for his plan was never to do things by halves. A source of great happiness to him consisted in contributing largely to religious and benevolent objects, and during this season of prosperity he was heard to say publicly, "My friends, do not be afraid that I am giving more than I can afford; God gives me my money by skipfuls, I am only distributing it by handfuls." A reverse quickly came, and the blow was so sudden that, using his own peculiar diction, "it was as if an angel from heaven had come down and proclaimed, 'that cords and braidings should be used no more.'" His immense stock was comparatively valueless, and he again lost all.

For the third time he went to work with his constitutional vigour and enthusiasm, saying, "Turn me into Nottingham park without money or clothes, and I shall die a rich man." Hitherto his profits had been made chiefly in warp goods. This time he turned to the twist bobbin net branch, and entered into the manufacture of black laces with success. He concluded his extraordinary career by carving out a business, which for a time he kept almost to himself by producing an imitation of Saxony lace. As he had predicted, he died possessed of considerable property two or three years ago.

Mr. Herbert had not only a good knowledge of the capacity for adaptation of the classes of machines he used, but he employed them appropriately and with characteristic confidence. He devised an ingenious

machine, in which he used pins and plates instead of a chain wheel. This was afterwards perfected and patented by Crofts. Several who were his fellow-workmen in the warp frame became in like manner conversant with its wonderful powers; guided and subordinated them to the production of new and beautiful articles, built up large and profitable businesses, and are enjoying well earned reputation and property.

Messrs. Whiteley and Co. in 1839 took out a patent, No. 8262, for the manufacture on the warp machine, of a tissue, called 'Taffeta.' On their plan the warp threads were to traverse in some measure. The principle of traversing on this machine is in this patent, and the merit of the discovery belongs to them, as to how it was to be effected on the *wide* warp frame from selvage to selvage across the machine. They disposed of this patent right to Messrs. J. and R. Morley. Messrs. Hemsley and Co. worked machinery by license under this patent.

In 1851 the Hemsley's took out a patent, No. 13635, for an improvement upon Whiteley's plan, by carrying the diagonal traverse from selvage to selvage by the operation of longitudinal bars on this wide frame; and in 1854, another patent, No. 981, for an improved manner of carrying the thread and making the selvage, thus perfecting the traverse system on the wide warp frame. Whiteley took out patents in 1853, Nos. 1107 and 1963, for making ornamented warp fabrics.

Messrs. Ball and Co. exhibited in the Paris Exhibition in 1855 a *double* looped taffeta made on a *circular* machine; therefore entirely different in its principle, mode of working, and resulting tissue, from Whiteley's and Hemsley's. This frame possesses the requisites of simplicity in construction, together with speed, quantity, and consequently, lessened cost of production. For the beautiful articles exhibited in the shape of silk gloves made up from this tissue, the jury awarded a gold medal to Ball and Co. This house gave notice for an English patent, but did not proceed to specification.

In 1864 Messrs. Gamble and Ellis obtained a patent, No. 689, which they described as being "for improvements in warp fabrics, and in machinery for making them," and explain as follows:

Instead of the warp fabrics consisting of pillars, each produced by looping continually a single thread, so as to make a chain resembling tambour work; which pillars were connected together into a fabric by other threads which do not loop on themselves, but which catch or link first with one pillar and then with another, and which may pass only from one pillar to the next, or may traverse a greater distance—this improved fabric differs from them, in that the connecting thread or threads heretofore caught one only of the three thicknesses of which such looped pillar is composed, while we cause them in each course to catch two of these thicknesses. The advantage of this is, that whereas on the former plan, in close work with a satin-like face, where in each course the connecting threads were carried sideways over two or more pillars, and on the face of the work float over the pillars intermediate to those which they catch, the back of the fabric has exhibited the pillars as heavy ribs, because the connecting threads only caught one of the three thicknesses of each pillar, and left the other two pillars on the back of the work. On our plan, by catching two of the three thicknesses of each pillar, this ribbed appearance is to a great extent got rid of, the back and front resembling each other, save that at the back the connecting threads do not float entirely clear of the pillars intermediate to those which they catch; but the connecting threads are held down to the intermediate threads by a single thickness of the pillar passing over them. In the open works also, catching with or twisting round two thicknesses of the pillars instead of only one, gives the pillar much more nearly the appearance of a true twisted pillar.

In this machine there is a needle-bar having needles with eyes, applicable to other warp-machines, each having a channel leading up to the eye in which the thread lies, not disturbed by loops of work passing over it.

Also there are in front of the work, points which catch the thread, rise or pass between it and the needle, and so leave a loop upon the points of which there are two to each needle. These points pass the loops sideways, and deliver them on the needles; which process by repetition forms the pillars.

This machine is more rapid than the ordinary warp-loom, because the connecting threads can be carried to and fro at each ordinary course, while in common warp-frames they can make one such motion only. The motions are also shorter.

Extra threads and guides may be used, to lay on or to work their threads into the fabric for ornamental purposes. And threads may be laid in from side to side; and these threads may form the sole connection between the pillars, and so form open net-work with rectangular holes; or these may be filled up by traversing the connecting threads.

Or the needle-bar, by a shogging movement, may pass the new loop through the next old loop needle thread. The machine thus arranged, the needle threads will produce a ground fabric without connecting threads; this may be ornamented by threads, laid into it by means of guides.

Warp-machines arranged according to the plans here patented are said to be suitable for the cheap production of strong curtains.

Plain Mechlin had given place to plain blonde, and blonde at length having become obsolete, a new and lighter article, *Zephyr Aerophane*, or *Paris* net, was largely made from the same machines. But, after maintaining with varied success competition with bobbin net, under the name of *Queen's*, made with a traversed mesh, and *Mechlin*, a straight down article, both of very light materials, and produced at low cost, about 1860 the warp Paris net succumbed; and the machines on which it was wont to be made have been unemployed and become almost valueless. Warp cotton laces and tattings have had to submit to a somewhat similar process. But a very light and inexpensive class of silk fancy nets have come into use. The old machines have in many cases been replaced by new wider ones, to which the Jacquard apparatus has been applied, greatly to their advantage in making heavy fancy goods. The rapid way in which these almost twin manufactures of warp and twist lace act and react on each other is very striking and important. Many of the articles may be said, if not to be common to both kinds of machines, to be so nearly allied as by the slightest difference in price or in the fashion favouring either of them to replace each other. They are always ready to supply their respective quotas to the general mass of the Nottingham lace trade. The machines are gradually assimilating in width, cost, time of working, wages, and vast power of production. They both require great skill and nicety of construction; and each must be worked by hands of a superior class, who, if put on short time, or their labour is suspended but for a brief season, are difficult to be retained, and can seldom be replaced. In both these departments of the lace trade, the machines are worked in factories eighteen hours a day, by two relays of four and five hours shifts. The quantity that can be made is therefore so large as, in times of difficulty, to issue in over production, and prices in both trades suffer accordingly.

CHAPTER XI.

BROWN'S FISHING NET MACHINE.

Robert Brown, who describes himself as a lace manufacturer, of New Radford, Nottinghamshire, took out in 1802 a patent, No. 2571, for the invention of—

"A machine for the purpose of manufacturing by this more speedy, simple, and neat method, fishing nets, horse nets, garden nets, furniture nets, nets for wearing apparel, and all other articles of net-work, having the same common diamond mesh and knot hitherto tied by the hand with the netting needle, in fishing nets; and also for manufacturing divers other figured meshes, with any thread, twist, twine, cord, jersey, or yarn produced from animal, vegetable, or mineral substances."

This machine was never made practically useful or profitable, for it has not being ascertained after much and careful inquiry that any net produced by it was ever sold. But questions of great interest and importance were raised within ten years subsequent to the date of the patent, respecting one or more of its parts and combinations, which will require attention, and render a full description of the invention necessary.

Robert Brown was a frame-work-knitter, and one of a number of clever artizans who were most of them more or less known to each other, and whose great object it was to construct machinery to make lace. This had been accomplished to some extent. Point net and warp net were being made in large quantities, but a *fast meshed* lace was not as yet achieved. This must either be a firmly *knotted* mesh, or a *platted* one, or a *twisted and traversed* one, or one *compounded* of two of these, as for instance *platted and traversed net.*

Now to accomplish by machinery any one of these ends was, by the outside world, considered as likely as to find the philosopher's stone; but by the mechanics themselves it was sought after with all the eagerness of

digging for gold: at any rate to attain to it was to gain the blue riband for invention in this class of machinery. Boswell, as we have seen, had made a *knotted* net of one thread by a machine. Robert Brown adopted the exactly opposite method of using his materials.

On his machine there were twice as many threads as meshes; these were divided into two equal parts, half of them were wound on the usual shaped wooden bobbins, and placed on pins upon a board behind the frame, from which they were carried separately, but in one row, to the front. The other half were wound on bobbins separately, each bobbin of about one-fourth of an inch in thickness, more or less according to the guage, between its sides; and these bobbins were placed in 'sinkers' on a pivot by springing the sinker open. The thread is held tight by passing through a spring. The spring is fastened to one of the inner sides of the sinkers, and likewise the catch by which the sinkers are drawn off and pushed on the bar as on a shelf. Plate IX. fig. 1. This bar moves on axles at the ends, and has a ledge on the front that enters the notches of the sinkers and supports them. These sinkers were doubtless so called from their working up and down perpendicularly like the sinkers of a stocking-frame. In operation the sinker or carriage and its bobbin were equivalent to a weaver's or hand fishing net maker's shuttle. There was another bar in front, about the width of the machine. This bar can be applied and removed at pleasure; it holds wire pins horizontally, and when applied presents these pins exactly to the hollow sheaths at the top of the carriages. The carriages are moved by hooks; these are the same hooks which operate on the threads to form the nooses; and the motion given to the carriages by the hooks draws them forward off the shelf, and then they are received on the wires of the other bar, or are put backwards again from the wires to return upon the shelf. The loops of threads through which the bobbins and carriages must pass are first made by the hooks and other parts of the machine, and are then drawn out or lengthened to obtain sufficient thread; they are afterwards expanded into a triangular form, so as to admit the points of the carriages into them, and the expanded parts of the nooses are thrown by the hooks over the top of the sinkers. Then the moveable bar with the wires is applied opposite to the hollow of the carriages, and seizing the carriages by the hooks, they are drawn off from the shelf and received in the wires; this brings the bobbins, with all the threads they contain, through the loops, which are afterwards drawn up to inclose and form a knot round the thread from the bobbin. The work is then thrown off the pins and the entire course of meshes is finished.

This process, and the machine by which it is accomplished, are very ingenious. It takes and uses as component parts a work beam, shuttle, and other well-known instruments, but some of them in new forms and subjected to new processes. Though at first sight it seems intricate, yet it would be comprehended without difficulty by those

accustomed to the stocking-frame and warp lace machine. The knotted fishing mesh it produces is perfectly sound in quality, and would come very low in price.

The parts of this machine and their modes of operation having been described, the first of the questions raised may be now considered, though they did not begin to occupy the attention of Nottingham mechanics and the lace trade until after the publication of Heathcoat's specification of his second bobbin net patent; to find flaws in which every effort was put forth by those who either envied the patentee's success, or desired to participate in the profits which would evidently arise from the newly-invented machine. The first question was raised by Robert Brown himself, who declared that Heathcoat's bobbin and carriage were only modifications of his 'sinker' and bobbin. In an interview with Lewis Allsopp, esq., a solicitor enquiring into these matters, he said, "Heathcoat and John Brown" (the traverse warp patentee in 1811) "have used me ill in borrowing my bobbin and case." And in a document of later date his son, Alfred Brown, says "my father's frame was the first that worked a bobbin and carriage. If Heathcoat can make a twist net without the bobbin and carriage, let him take the merit of it, otherwise I claim the merit for Robert Brown." And in 1843, in conversation with the author, he remarked:

"The invention of the bobbin and carriage is comparatively as good an one as the wood needle blocks of Lee, the inventor of the stocking-frame; the wood types of Faust or Guttenburg; or the spinning mule of Arkwright, the assumed inventor of the spinning apparatus. Robert Brown's patent had the advantage of some years priority. He fell into poverty and received parish relief; became insane, and attempted self-destruction; had he retained his faculties he would have claimed his right by an injunction on Heathcoat. Things would have been much better for his family after the last trial between Heathcoat and the trade, had there been no collusion or fraud; but they were fearful that, in their contention, R. Brown's claim would be established, and therefore compromised."

Alfred Brown denied all merit to Whittaker in regard to the bobbin and carriage, or that he ever put together a machine on which bobbin twist lace could be produced. It was stated by G. Henson, that—

"Whitemore, an apprentice or workman of R. Brown's, seeing a boy play with a thread wound round a very flat bobbin and being

let down towards the end of the string and suddenly checked, it rose and wound up again; he was led to think that if he could use such an instrument in another implement, he might by that means get a thread to pass round a warp thread: a thing tried for during fifty years, and not then accomplished."

It is further said that when Whitemore had imbibed the idea of a spring regulating a bobbin, he became so excited that his shopmates thought him insane. This is intended to account for Robert Brown's devising his sinker and bobbin in 1802; and it was expected in 1815, that Whitemore would have verified it on oath. He was not, however, called upon to do so. The idea that, by his sinker and bobbin, Robert Brown originated this important part of the twist lace machine became prevalent, and was a good deal relied on by infringers of the patent—the heads of the Nottingham trade, masters, and their journeymen, who for a time shewed him personal attentions, which were, however, soon discontinued; though for some years, in consideration of his misfortunes, he was paid 12*s.* weekly out of a trade fund. A patent, No. 2760, which he had taken out in 1804 for a machine to be affixed to an upright warp or Vandyke knitting-frame without sinkers, had unhappily proved also a failure, being superseded by a horizontal one. Though it is stated that he sold his fishing net machine for £600 to a gentleman at Gloucester (in whose hands it did not succeed), the prosecution of his inventions swallowed up his resources. It is greatly to be regretted that a mechanician of such undoubted ingenuity, and who, under more favourable circumstances, might have achieved success and fortune, should have been left to pine away into a moody melancholy.

Every part of Robert Brown's machine had in some form or other been used before; the 'sinker' and its bobbin amongst the rest. It is a shuttle in a different form, and used for a different purpose to that of the ordinary weaving-loom. The same motive and necessity, though in each case for an entirely different purpose, induced R. Brown and Heathcoat respectively, to reduce their bobbin and carriage into as thin a shape and compass as they could get it to occupy; each performed the real purpose of a shuttle, but in ways,

in the two machines, having no relation to each other. Heathcoat had seen Brown's specification, though not his machine; and may have had his thoughts directed to the practicability and use of a thin bobbin, spring, and carriage by it. He gave credit, as will be shortly related, to G. Brown for his shuttle. But Brown's fame as an inventor does not in reality stand upon this bobbin and carriage, or on any other part or parts of his machine separately, but upon the ingenuity and novelty of his combination of them. For this he deserves very great credit. The result was a perfect article, which, but for special reasons in relation to the use that could be made of the net he produced, must have been the source of much profit to him. Like Boswell's, his frame remained unused, because fishermen's nets cost them merely the sum paid for materials, their leisure time only being occupied in manufacturing them. That this is the just view of Mr. Robert Brown's shuttle, is fortified by the following statement made after examining it, and given in evidence by Donkin, Sylvester, Farey, Millington, Brunel, Hawkins, and Ostell:

"That it is no more like Heathcoat's carriage than it is to the old shuttle of the weaving-loom; that they had no affinity in use or effect, being intended and used for entirely different purposes, and were each detached parts of complicated machines."

Claims to this invention were put forward on behalf of John Lindley, Edward Whittaker, B. Thompson, and C. Hood, which will be noticed when the inventions of John Heathcoat are described.

The second question which has been raised, in reference to this patent of Robert Brown's, is a far more interesting one, and shall be given in substance from the words of Dr. Ure, in his *History of Cotton Manufactures*, vol. II., p. 342:

"Without impugning the merit of Mr. Heathcoat, it may be stated that the principle of his patent has been embodied since the year 1803 in a machine for making fishing nets, the invention of Robert Brown or his partner George Whitemore, both of Nottingham. Mr. Morley, the very eminent bobbin net manufacturer, of the great firm of Boden and Morley, of Derby, pronounces the judgment 'that this machine possesses all the essential principles and properties of Heathcoat's patent bobbin net machine (of 1809 or seven years subsequently to Brown's), and is to all intents and purposes a bobbin net machine.'"

Dr. Ure goes on to say:

"To this machine must be traced the origin of the curious invention of the bobbin and carriage; to it must be referred the method of using two divisions of threads, warp and bobbin; and to it alone must be attributed the beautiful idea of passing, or as it is generally termed, twisting two divisions of threads with order and regularity and without entanglement round each other."

After referring, for proof of the above, to the specification which it is almost incredible that he or Mr. Morley could have examined, he further says:

"The idea of reducing the thickness of the bobbin and carriage to a scale fit for the fine meshes of bobbin lace, seems to have originated with Edward Whittaker, of Radford, who, knowing Robert Brown, had knowledge of his fishing net machine."

These statements, coming from such an authority, go to withdraw from Mr. Heathcoat his title to the invention of the bobbin net machine, and will be most appropriately considered when an account of the origin and a description of that invention has been given. Till then the reader will probably preserve his mind unbiassed by them.

Robert Brown died about the year 1818. His son, Alfred Brown, has shewn proof of hereditary mechanical skill in the construction of a machine capable of producing some of the most intricate combinations of threads hitherto made. Specimens of these meshes indicate the complex character of the mechanism by which they must have been produced. This and his want of means has hitherto prevented its being brought into use. He is a small newsvendor, of respectable demeanour, and is possessed of much intelligence. It is to be regretted that his abilities have not been exercised under more favourable circumstances.

CHAPTER XII.

HORIZONTAL LACE PLATTING MACHINES.

Mr. John Moore, a native of Leicester, was a small hosier, and his sons were there taught frame-work-knitting. Of these, John was living at Croydon about the year 1800. He was previously to that time employed in experiments in making lace machines, while his brothers, Benjamin and Olive Moore, were engaged making 'point net' lace. John Moore turned his attention at first to the production of twisted net, and then in 1810 of platted net by machinery. He had by mechanical means obtained a twist on both sides, carrying threads over each other and then back again; and having constructed this horizontal frame, worked it for some time, making a twisted but untraversed net. At length he found means whereby he platted some of his threads also; they were still untraversed, and the net meshes straight down ones.

According to the account of his brother and nephew, the *pillar* or longitudinal sides of his perfect hexagon mesh were platted, being composed of four threads, two of which had been twisted twice round each other diagonally and other two the same, forming the two upper sides of the mesh, and having all passed together the platting process twice, were separated, and each thread of each pair was again twisted twice round its fellow, to form the two lower sides of the mesh, preparatory to all four entering into the platting combination again. By this method a sound and beautiful straight down real Mechlin mesh may be produced, and which it is presumed John Moore effected. It is uncertain whether he ever arrived at traversing the threads after platting.

As there was no patent, there was no specification; the machine has disappeared and none of the net can now be found. Two of those who worked in these frames, Mr. Olive Moore and his nephew Stephen, are still living. The former with Benjamin Moore helped John Moore, in putting up several to make first twisted breadths, and then platted wide net at Croydon. Yet

neither of them has a perfect recollection of the mechanism or mode of working of either of the machines, but describe the arrangements and processes of the latter thus:

"It was a horizontal machine in two distinct parts, only connected by the threads used in the construction of the net. These parts at the beginning of making a piece were placed distant from each other the length of the room. The place in which the last of John Moore's platting frames was worked, on its being brought by him to Nottingham, and sold to his brother Benjamin, is in Parliament Street, and is thirty-three feet long. Allowing three feet at each end for the machinery, the full length of the extended threads would be twenty-seven feet. The pieces, while making, drew up the machine from the lower end, it moving on trucks, towards the upper end; and they would be so much the shorter than nine yards as the thread would be taken up by plat and twist. At the upper end was the work roller and the under point bar, which held up the work already made, while the top point bar came forwards to bring with it the plat or twist as it was formed. There was no division of threads, all being carried in one line from the machine at the upper end of the room; and at the lower end each thread was tied into a loose needle having in it a catch or notch. Each needle dropped into a slaie. Below this slaie and the threads was a bar with points, which moved such of the threads as were necessary to form the plat by means of the notches or catches to an upper slaie made like the lower one, and on receiving these threads carried them by a movement of the whole of this upper part of the machine to a position where by the side (shogging) movement it placed the threads so as to help to effect the plat, when the remaining threads had performed a similar movement. As the platted or twisted sides were formed, a roller the width of the net (about forty inches) was placed so as to pass from between the top and bottom catch bars, at that end where the platting or twisting had just been effected, and then slide up to the other end machine, whose upper point bar was waiting to take and deliver them to the under point bar, to be added and held to the work already made."

The expence of constructing this machine was large. Only about two yards in length of plain net could be made in a week from No. 300 yarn, costing 16 guineas per lb. The whole of the net produced was sold to Mr. James Fisher at five guineas a yard in length and forty inches in width, until from its high price it was superseded by twist and traversed bobbin net. This machine and the first *traverse warp* machine made by Benjamin Moore were long kept as curiosities, but for want of a public museum they were at length broken up as of no further use. Mr. Stephen Moore says, in conclusion, "the durability combined with the beauty of this platted pillar net was beyond any other machine wrought net hitherto produced."

John Moore, finding that platted nets were too expensive for general use, turned to the traverse warp machine, in the discovery and adaptation of which his brother Benjamin enacted so prominent a part.

This early effort to make so perfect an article as a *true* Mechlin net is very interesting; for it shews after what the indefatigable mechanics of Nottingham were in search, and to what they aspired—a perfect imitation of the best foreign cushion lace. An extract from G. Henson's MS. on this subject is therefore given:

"Tarratt went about 1780 into Northamptonshire to observe how *bone* (cushion) lace is made. On his return he tried (for Morris) to make twist net by the use of all warp, *fastened at both ends*, and by employing six distinct point bars. In this effort he was followed by others—as by John Moore, Croydon, for Frost, of Nottingham, in 1799, and in 1809 by the same machinery improved; by Hill, for Nimmo, of Nottingham, 1805 to 1816; by Widdowson, for Messrs. Woodward and Urlings, of London, 1816 to 1824. During this period the *fast warp* plat machine sometimes made three twist Brussels net, having four threads to a pillar. This machine was the swiftest of all modes of putting in twist, but lost time in securing it, the point bars being drawn by a windlass. Tarratt and Moore fastened the threads at both ends, thus making lace at both ends at once, using two point bars. Moore found out a plan of putting the threads on (loose) pins at one end, thus unlapping them and making a single piece only of net at once. On this plan the Croydon workmen made three racks of two hundred and forty meshes each a day. There were about twenty machines at work at Croydon, London, Nottingham, and Basford."

In the foregoing extract, G. Henson seems to intimate that John Moore's plan of making plat pillared net was identical with one in work from 1816 to 1824, at Basford, for Miss Woodward, (connected as embroidress with Urlings, of London) by Widdowson. These machines were said to have been constructed by or for one Mr. Thomas Hill. This invention has also been attributed to Jeremiah Brandreth, who was executed at Derby for treason; nothing is known to justify the statement. The machines were carefully withheld from public inspection. Some time before 1824 Mr. Thomas Robinson had also an interest in them. They were at one time removed to rooms on the premises of Mr. Samuel Hall, and worked there. His connection with Urlings may probably account for this. Mr. John Sisling is possibly the only one remaining of those who made this plat net

at Basford. A costly and beautiful veil of the finest net made on this ground and ornamented with real Brussels flowers, is the only specimen now known to remain of the kind. The mesh has two pillars of four threads thrice platted and two twists on each of two sides and three twists on each of the other two sides completing each mesh. This square was one of a large number sold in 1822, for the then price of fine three-twist bobbin net, viz. £1. 5*s.* per lineal yard, 54 in. wide. It must have entailed a serious loss on the maker, and though the most excellent machine wrought article ever seen, scarcely distinguishable from *pillow* work in the mesh, its cost was beyond the consumption of that day. So it soon disappeared from the market. It has been replaced ever since, as ground net for the application of Brussels pillow sprigs, by extra fine three-twist nets. Henson (MS.) remarks:

"There has not been better lace either in Buckingham or Brussels ground than some of these fast warp Brussels machine *breadths*. They had for a time a ready sale at £1. 11*s.* 6*d.* a-yard for sixty holes in width. Flemish pillow lace of the same width sold for £2. 5*s.* 0*d.* the yard at the same time."

Thomas Frost, in 1794, made a net by using—

A square bobbin sliding in grooves, the warp shogging (shifting) sideways right and left; the work beam with the work and point bars were lowered to the bobbins as the thread was shortened by making the net. Upon turning the machine a quarter round the point tackle rose again. There were no carriages.

In an endeavour to produce bobbin net, carried on by Green and Simpson, in 1707—

They wrapped the traversing threads round wires placed in long carriages held to their tension by strong springs. These threads rode in pivot holes in the springs at one end of the wires, and their other ends were in pivot holes in the carriages. By this method good net was made; but the wire held so small a quantity of thread before it became too thick to pass through the warp threads that a piece only one yard in length could be made upon it.

Simpson by intense study brought on a brain fever from which he died, and Green then abandoned the effort, and is said to have died of unremitting and unrequited study.

Afterwards it was proposed to warp each thread on two such wires placed a little apart, and so get a piece

of double length. Even in the single tier machines of later days when short lengths have been made, it has always been an objection, especially in plain nets.

Mr. William Hayne, the well-known lace manufacturer of Nottingham, constructed the model of a machine in 1799, intended to produce bobbin net—

It had several tiers of small bobbins with a rack or teeth on the edge of each bobbin; the main warp threads passing through the centres of the bobbins; the other threads being twisted round the centre threads, while revolving after being crossed at the close of the hole, then twisting back again. The plan was never put into operation.

Mr. Hayne hung up this model in the lobby of his warehouse, the purpose being, as he said, "for his 'point net' workmen to admire it, and if they could to improve upon it."

About the same time George Pindar, of Nottingham, tried to make bobbin net by—

Wrapping his bobbin threads round perpendicular flat wires. He also used a perpendicular warp with slaie points, so that he might keep the wire bobbins square while they were passing through the warp threads.

Other particulars of the plan have not been handed down beyond the above and the fact of its want of success.

In 1806-7 William Potts, of Nottingham, tried to make twist net.

He used a perpendicular warp fast at one end, the threads of which he twisted by passing hooks placed and working at the back and front of them, and catching and drawing them sideways round each other in passing through them.

Before he had accomplished his purpose, he went to Croydon, where he soon after died, leaving the attempted machine in an unfinished state. No doubt he went to Croydon to be near John Moore, if not to be employed by him on his platting machine.

In 1808 William Elliott, of Nottingham, employed himself in putting together lace machinery.

He used tubes through which to pass his stationary warp threads, and on the outsides of which tubes were catching instruments whereby he carried the traversing warp threads round; and upon crossing for the traverse were racked round and twisted the contrary way.

The attempt was unsuccessful.

The following is a very imperfect account of a machine, which was much talked of at the time (about 1808) attempted by Richard Palmer, of Bingham, where he was also engaged in perfecting the processes of stereotype printing:

> In the proposed lace machine he used very small brass bobbins shaped like common winding bobbins, having teeth to be racked by an under pinion bar; the warp threads when racked being in the teeth, and by having two such bobbin bars the crossing was effected by removing the warp threads one bobbin each way.

This machine was intended to shift the warp from bobbin to bobbin by one motion, to make the twist by one racking movement, and to run up the twist by point bars in the third motion. Palmer died early leaving his attempt incomplete.

CHAPTER XIII.

LACE MANUFACTURE.—1800 to 1810.

It has always been necessary in every business to secure not only the best machinery and workpeople, but also excellence in materials. This was eminently the case with the English and foreign lace trades, whether dealing in articles made on the cushion or by machines. Both classes were eminently indebted to a native of Nottingham, Mr. Samuel Cartledge, for an improvement in the manipulation of fine numbers of doubled cotton yarn, whereby that article was first rendered suitable for the manufacture of pillow lace, for which linen yarn had hitherto been the chief and almost the only material. In the eye of the connoisseur in lace, no doubt exquisitely fine linen thread used still for imperial and royal purposes will be preferred at whatever cost. But for any less exalted purposes the fine cotton yarns, which were introduced in 1805 to the acceptance of English cushion and machine lace makers, and since universally employed both at home and abroad, have some special advantages to recommend them. The cotton thread is more elastic than linen yarn, therefore breaks less in the hands of the lace maker. It gives to the finished article a more brilliant appearance, and is much less costly. After encountering much and deeply rooted prejudice carried to extreme lengths, this gentleman succeeded in establishing the use of his carefully twisted and otherwise specially prepared cotton lace yarn in the Buckinghamshire and Northamptonshire pillow lace districts, where, in February, 1815, at a meeting of manufacturers—

"It was resolved unanimously that Mr. Samuel Cartledge, of Nottingham, is entitled to the thanks of the lace manufacturers for his invention of cotton thread used in the manufacture of British lace,

and for his introduction of the same to the trade on liberal terms, and that the chairman do communicate the same to Mr. Cartledge.

"(*Signed*) J. H. HANDSCOMB."

From thence the use of cotton thread spread to the other English lace district of Honiton. And at length, just after the resumed manufacture and consumption of pillow lace on a large scale in France, it gradually became the material of which all but the most expensive articles were made (silk excluded), and, according to the testimony of M. Aubry, "it is incontestible that the use of cotton in place of linen thread, has greatly assisted to develope the fabrication of lace by augmenting the consumption and facilitating the production."

Although silk was used principally in the point net manufacture, which was the chief constituent of the lace trade at Nottingham from 1795 to 1815; yet there had been some amount of warp and other cotton lace made from coarse yarns since 1770. The advent of the twist net made for years entirely of doubled cotton yarn, and which required a strong, and even fine thread, gave rapid impulse to the demand for it in its most perfect form. Mr. Cartledge gained by supplying this material a considerable fortune—a well deserved reward for his ingenuity and persevering enterprise.

Messrs. Houldsworth, of Manchester, became spinners of these fine first quality yarns. Nos. 200 to 300 were principally used. Their nett list in 1805 was for No. 200, £3. 3*s*. 6*d*.; 220, £4. 1*s*. 6*d*.; 240, £5. 6*s*. 6*d*.; 260, £7. 3*s*. 6*d*.; 280, £9. 9*s*. 6*d*.; 300, £12. 8*s*. 6*d*. per lb. These prices continued for many years; and as finer numbers were enabled to be spun, still more extraordinary prices were obtained for them. It is said this house sold in one year £70,000 worth of fine yarns for lace purposes alone. In 1812, No. 320 were sold for £15. 2*s*.; 340 for £22. 6*s*.; and 352 for £27. 8*s*. per lb. Well might that very clever and successful house say, when writing in reference to their lists of prices, "In making similar researches to these, it is some satisfaction to look back upon good old days, when profits and prices were more substantial than at present." No. 100 has been sold since then for 2*s*. 4*d*., and No. 200 for 7*s*. 6*d*. per lb.

It was in 1808 that Mr. Joseph Page, of Nottingham, made the first piece of double press point net, in which doubled fine yarn was used. It was sold for 3*s*. 6*d*. the square yard.

The following particulars given in 1831 by competent authority will afford some idea of the extent of the

production of lace thread, and the importance of the business to the spinners and doublers of that day:

There were 608,000 spinning spindles, 251,000 doubling spindles; of the latter, half were in or near Nottingham. The total value, including buildings, steam engines, and gearing, was £601,510, requiring also a floating capital of £200,000.

There were 3472 adults employed in spinning, at earnings varying from 8*s.* to £2 weekly, perhaps averaging 17*s.*; and 3906 children gaining 2*s.* 6*d.* to 7*s.* weekly, averaging about 5*s.* Hands employed in doubling: 861 adults from 8*s.* to £1. 10*s.* per week, averaging 12*s.*; and 1449 children from 2*s.* 6*d.* to 7*s.*, averaging 4*s.* 6*d.* 1,730,000 lbs. of raw sea island cotton wool were consumed, costing £129,750; and 1,110,000 lbs. of lace thread was produced, of the average value of £550,000; at that epoch leaving small gains for the employment of capital and labour in spinning and doubling cotton yarn of these fine numbers. In 1836, 1,850,000 lbs. of sea island wool were consumed, costing £185,000, producing 1,210,000 lbs. of yarn, worth £624,330. A large increase in the consumption of cotton yarn of numbers below No. 120 has since taken place for the manufacture of curtains and 'foundation' nets, but an approximate estimate of quantity or value cannot be obtained by us. The entire consumption, including that of France and Belgium, has now become very great.

The question of an equitable mode of reckoning in payment for work done by those employed in the making of any kind of lace on the loom, had for many years caused anger and contention, which increased with the rapid growth of the trade. The practice of the employers in taking in work from the machine was to measure out twelve stretched out arms' length of the piece, and consider them to be twelve yards, and to be paid for as such to the workman. This was manifestly so loose, and, by the necessity of the case, so unjust a mode of dealing with an elastic article like lace, as to make it a matter of surprise that it was borne with so long.

On the 24th August, 1809, the workpeople addressed the lace manufacturers then assembled to consider of any measures proposed for the good of the trade, and pointed out the equity of paying by count in length, shewing that the plan was quite feasible. Their memorial was signed and presented by John Blackner, the future historian, and three others on the part of the workmen. An instrument was devised by Handley, a lace maker of Nottingham, (afterwards poisoned in a frolic) and Thomas Brookes for the purpose of exact measurement by the movement of the machine itself acting upon

a tooth and pinion wheel, to which were attached a bell and hammer which announced the completion of every 240 meshes in length. To shew these, marks were placed on the selvages of the pieces. This 'rack' as it has ever since been called, was applied to the point net machines in 1810 by James Oakes, a workman of Sneinton, and by Mr. William Hayne; and in 1811 by Thomas Roper, a workman to the warp machine; and to the carrier bar of the bobbin net machines by Jonathan Brown, afterwards living at Calais; and notwithstanding the objections of Mr. Nunn, a large lace manufacturer at once became universal. It has since been the standard of measurement of labour in every department of the lace business, and of length from the maker in selling to the finisher for the market. As a check upon any fraud by the workman, or possible error in the rack, it has been the practice to enable buyers to ascertain for themselves the length of their pieces of traversed twist bobbin net, by filling one bobbin with a *coloured* thread, which placed at one end of the row at the beginning of the piece, by its diagonal courses, indicates infallibly the number of holes in its length. A flagrant case of misdemeanour in this matter was punished with marked severity by the Judge of Assize before whom it was tried forty years ago; since then similar frauds have become very rare indeed. Finished goods are sold by the yard, or dozen yards, or the article, as the case may be.

Where fancy lace is in question, in which there is much weaving of fine work, twisting, and pearling, combined with little elasticity, the Nottingham manufacturers are beginning (1866), when disposing of these goods as they come from the machine, to charge them by the yard and not by the rack as hitherto.

Our narrative now approaches the invention of the bobbin net machine. While tracing the events that previously occurred in the Nottingham lace manufacture, it has been seen that many persons in that district had been endeavouring, since the addition of the point net machine to the stocking-frame, to produce by machinery a more exact imitation of twisted and traversed cushion lace, and that some of these died in poverty, and others

became insane. The difficulty lay in providing by mechanical movements for the threads twisting round each other, and then travelling in three separate sets or directions; viz., half of them longitudinally, and of the other half part to the right hand diagonally and the other part to the left hand diagonally across the nets. John Moore and the others, whose ingenious labours have been described, had not succeeded in solving this problem. They had got the twist but not the traverse; the latter being essential to the soundness of the twisted net. Blackner justly intimates "that neither Morris, Lindley, nor Robert Brown made *traversed* net, nor furthered it by their efforts."

Amongst those who were afterwards engaged in these attempts were Edward Whittaker and Charles Hood. These names have been much linked together by their connection for a time with each other, and by subsequent legal enquiry as to how far they proceeded in them, and what was the result of their efforts. The accompanying (Plate III.) will give some assistance in arriving at an accurate conclusion upon these points. It is a facsimile of a pen and ink drawing representing the most important parts of their respective machinery designed to produce lace. It was exhibited in an action in 1813 on the subject of Heathcoat's patent right to a bobbin net machine, and is no doubt correct.

Whittaker was an uneducated man, yet possessed of mechanical talent; but being of intemperate habits his application to what he took in hand was fitful and uncertain, and as a consequence his circumstances were ordinarily very low. In the prosecution of his business of a 'setter-up' of machinery, he had taken a warp machine to France. On his return, he stated that he had there perfected a plan for making bobbin net; spoke mysteriously about his speculative movements; called some parts of his machinery 'indivisible,' and others 'invincible.' At this time Mr. and Mrs. Whittaker lived at New Radford, where Mr. Olive Moore knew him; and though he did not see what he was doing, yet remembers it was said afterwards, that "Whittaker's bobbin and carriage were the foundation of Heathcoat's."

Whittaker's own statement was, "that in the machine he constructed there were eight or ten threads in an inch, and that on it he produced an article shewing wavy lines like 'blonde' (Mechlin) net."

He seems to have used a comb bar like the jack bar of the stocking-frame. There was no warp, and all his threads were put on bobbins, each of which was fixed in a nick cut in a sort of carriage. Every other bobbin had to be lifted over the next one and let down into the vacant space. The first ends of the threads were fastened to the further end of this horizontal machinery; and the twist obtained was pushed up by the hand. When he attempted to cross the threads the bobbins tumbled out of their places. This attempt presents the use of a modified shuttle and pirn, or an ill arranged bobbin and carriage, not reduced to the space occupied by an interstice of lace; and the other parts, so far as they are known and can be understood, were not calculated to attain the end proposed.

The machinery, before being taken to Loughborough, was put into the hands of Leonard Elliott and Edward Morley, by James Hood, neither of whom could make it work. Mrs. Whittaker, then a widow, stated, in 1815, that her husband made some small pieces of lace from this machine, in which she said "there were besides comb bars and drivers, brass bobbins and carriages made by B. Thompson, the brass turner, before it went to Loughborough;" on the same occasion, Mr. James Taylor stated:

"That being partner in 1805 with Mr. James Hood, as hosiers, in Nottingham, Whittaker entered into an agreement with him about that time to bring and work a model of a bobbin net machine. Seeing a small quantity of lace on it, he was supplied with money to construct a machine. It had bobbins (called from their size 'guinea wheels'), carriages, jacks, comb bars, and drivers or points. Taylor, a joiner, made the wood work; B. Thompson the brass bobbins and carriages; Dalby, of Loughborough, the iron work. After a time Charles Hood persuaded them to let the machinery be taken to Loughborough, where his tools were. Whittaker went to instruct in the work. Taylor became tired of the delay and expence, and they gave up the business, upon which Whittaker returned to Nottingham."

Mr. James Hood, the partner, also stated—

"That he saw lace attached to the machine, but did not see any made; though an additional bonus was to be given to Whittaker when the machine was *seen* to make lace."

He stated also—

"That he had seen Whittaker make some lace on a cushion, and had no doubt now that what was on the machine was thus made.

Whittaker was a dissipated fellow, and he (James Hood) having expended £500 on the attempt, declined further dealings with him. Whittaker's frame had half the threads drawn from a warp beam and half the threads wound on bobbins mounted in carriages."

On this statement Mr. L. Allsopp, the well-known solicitor of Nottingham, has indorsed, "James Hood knew nothing of either Whittaker's machine or of bobbin net lace." Mr. B. Thompson, in corroboration of Whittaker's claim to having made net by machinery, said that—

"He had made, in conjunction with Whittaker in 1804-5, bobbins and carriages for a machine intended to make lace, and that they were of the same sort and use as those described in John Brown's patent of 1811, and without which that machine could not make lace."

It will be observed that none of these persons speak of a portion of Whittaker's threads being put on a warp except James Hood, who on that point was certainly misinformed, as the following testimony will amply shew.

Whittaker's machinery was shewn to Mr. Sylvester, a competent civil engineer, who thus speaks of its arrangements and powers:

"There was no provision for taking up twist by points, as Whittaker seems to have been fully employed in contriving to effect the twist. No provision was made for shogging by a side movement of the bobbins when in one row, except by lateral contact from pressure on the end ones, thus moving the whole row sideways. This was the probable reason that he only used four or five bobbins, though his comb bar was two feet long and the bobbins four to the inch. He could not effect a crossing to unite the pairs of threads he had twisted together. On his machine that was impossible, and he always spoke of it as the 'desideratum.'"

Mr. Sylvester further stated—

"That having examined the machinery constructed by Morris, Robert Brown, John Moore, E. Whittaker, and Charles Hood, he found that none of them had two distinct set of threads that could traverse, and none of them required bobbins. Whittaker never finished a machine of any kind; his materials when in Charles Hood's hands produced some lace; but it was made without bobbins, was straight down, and therefore without traverse."

Mr. Joseph Harvey, well-known as having accurate knowledge of lace machinery, after inspection of this range of machines, fully coincided in opinion with Mr. Sylvester. Thomas Roper, a setter-up, stated that—

"Whittaker, thinking that Buckinghamshire lace might be imitated by machinery, concocted a plan with B. Thompson, of machine notoriety, for constructing a model; and being supplied by a Nottingham house with money, they so far succeeded as to complete an imperfect model on which they made the twist mesh, but got no further."

Charles Hood, in 1813 and again in 1817, declared—

"That Whittaker had made a kind of machine of wood, tin, and iron. One part consisted of what he called bobbins; they were like a lark whistle, and about three or four to the inch. He tried during a year to make it work but could not. He shewed Charles Hood lace which he said had been made from it, but it could not have been so; no doubt it had been made on a pillow. Whittaker's machine being useless, as one for making bobbin net, he returned to Nottingham."

Charles Hood was the brother of James Hood, and a frame-smith employed by Taylor and Hood. He appears to have been a clear-headed mechanic. When James Hood began to doubt Whittaker's ability to perfect his machinery, Charles Hood inspected it and said that—

"He found there was no beam used, nor any division of threads, nor any means of crossing them; and judging him after a year's unsuccessful efforts unable to devise such a plan, he proposed to James Hood to take the thing out of his hands and begin afresh on a method of his own. Upon this proposal, in 1806, he, his brother, and John Wallis, of Loughborough, set to work to produce a bobbin net machine. At first they used rivetted bobbins and carriages, which were lifted over one another by pullies, the frame being a horizontal one, and thus a twisting process was carried on. They had only one comb bar, which was divided into two parts, each to receive half the bobbins and reverse them alternately; every other bobbin being raised half the height of the carriage, and then some sharp iron pins entered small eyes or holes in the bobbin, by which the lower bobbins were raised to the height of the top bobbins and put into their place; the top bobbins took the place of the lower, by which means the twisting was made. The next time half the number of bobbins, consisting of every alternate two bobbins, the two middle bobbins of every four bobbins, namely, a higher and a lower one, were taken up by the iron pins and changed as before, by which the crossing was made. The above movements were repeated, but the threads only passed through the like course returning to their first position, not traversing beyond it."

In conclusion Charles Hood stated—

"That Heathcoat's was the first traversing machine he ever saw or heard of. In his own attempt he carried up the twist and the crossing a distance of two yards or more, by means of a row of wooden and afterwards of iron pins or points. The machine was still

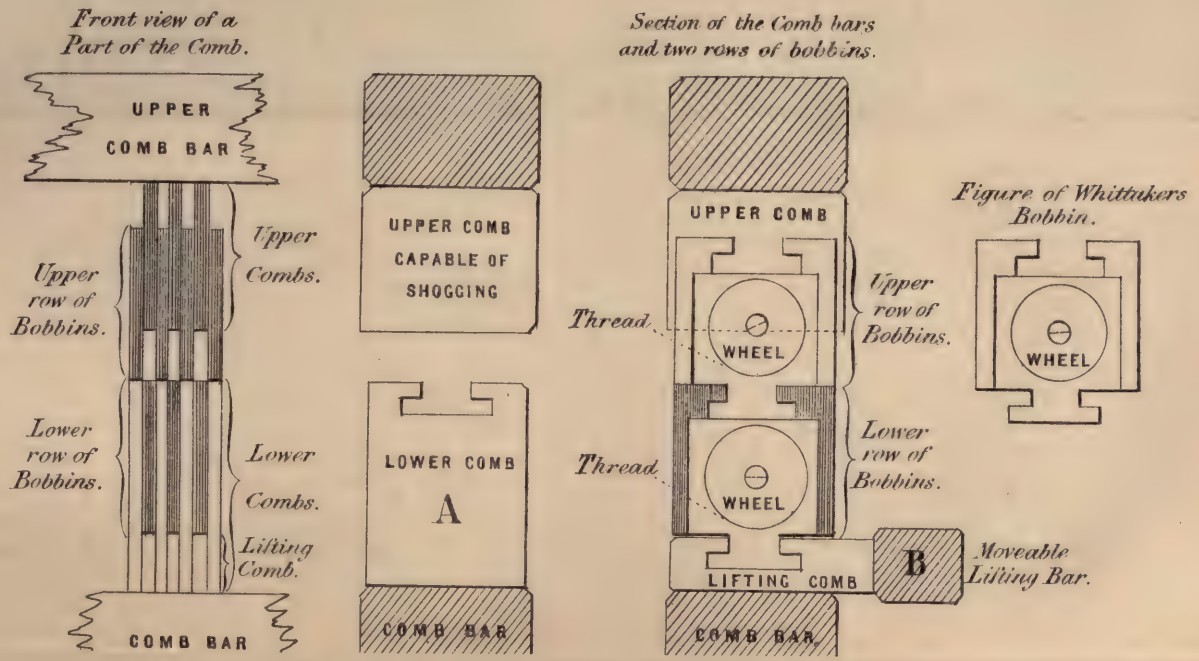
imperfect, and he never made lace of greater breadth than nine inches and in pieces of two yards in length. Altogether he produced about twenty yards on the two frames which he constructed."

An original outline of this lace is given on Plate III., shewing the machinery. Further proceedings he said were stayed from want of funds. This plan of C. Hood was eventually nearly allied to those of John Moore and others, in its mode of getting the twist and using yarn in lengths of only a few yards, tied at one and weighted at the other extremity. Blackner must be under a mistake when he says, "he had a bobbin and carriage made he believes in 1803, by a person named Hood." Hood nor any one for him speaks of such an invention at that date—a silence, if the fact were so, altogether incredible amidst the discussions then and since carried on.

G. Henson said, "Hood making twist net moved his carriages by hand with long fetchers; he tried to take up twist by spoon ticklers, but he could not traverse the carriages." The mention by Charles Hood in his evidence, of Mr. John Wallis, of Loughborough, led the author to seek an interview with his son, Mr. John Wallis, jun., residing at that time (1846) at New Lenton. He was well known as a very conscientious man, and one who would certainly declare the truth so far as he knew it. He stated that—

"He remembered Whittaker's unsuccessful effort to make bobbin net lace at Loughborough, and had no doubt that he never made lace on his frame. It contained a comb bar, inserted into which were bobbins like the drawing (Plate III.) each placed in a slit in its carriage, and held there by a spring. Every other one of these was lifted over the next and then let down into the vacant space. The others were then caused to do the same. The threads were all fastened at the further end of the machine, and the twist thus obtained was pushed up by the hand. It was after a while evident that Whittaker (who had been in France and professed to have got his ideas of making bobbin lace by machinery there) knew not how to perfect his machine so as ever to make lace upon it, so he was sent away, and Charles Hood was entrusted with the further prosecution of this effort by Taylor, James Hood, and Wallis. In a while he made two machines on which some narrow strips of twist net were made, the first of which was sold to Mrs. A. Brewin, of Loughborough. In this machine there was only one system of threads; there were bobbins on which the brother of John Wallis, jun. used to wind the threads; there was a comb bar and a row of pins upon a cushion to force up the twist. The produce was not a traversed but a straight down twisted net.

SKETCH OF WHITTAKER'S ATTEMPT TO MAKE A LACE MACHINE.



"Charles Hood was very dissipated, and would very likely talk at the public-house of what he was doing. If through Bailey or other workmen of Heathcoat's, the latter heard something of Whittaker's bobbin and carriage, while he himself was endeavouring to invent a bobbin net machine, it was not surprising nor unfair. Heathcoat was on rather intimate terms with Wallis, sen.; but the latter often in after years declared the former never put an enquiry, or shewed any anxiety for information as to Hood's proceedings, or referred to his own. He had been four or five years in getting his first patented machine to work; and the only reason they had for supposing he had been assisted in getting so entirely different a one as that described in the second patent, was its appearance in the short space of nine months after the first.

"My father gave up supplying Charles Hood with money. James Hood treated him haughtily, and sent £20 through another hand to Charles Hood, with the message 'that if the lace could not be made as fast and as cheap as warp-lace, it would not do;' on which Wallis stopped the concern. Whether anything could ever have been made of it under the most favourable circumstances, his father could never determine. Some time after, Charles Hood told him that Heathcoat was willing to buy the machines for £5, the price of old materials. He agreed to the sale, and that Charles Hood should have the proceeds."

The following circumstance which occurred during preparations in 1817 for the trial, Heathcoat *v.* Grace, for infringement of Heathcoat's patent, will confirm what has been related in reference to Whittaker's proceedings. Thomas Abell, a Nottingham lace maker, saw one Weston in the Fleet prison, a month before the trial, who told him that he had a model of a machine at home which he had bought from Mr. Taylor, late partner with Mr. James Hood, and for which Mr. Wm. Morley had once offered ten guineas, and he now wished to sell it to either of the parties in the pending suit. This was communicated to Mr. Boden, Mr. Heathcoat's partner, and the model was sent for from Nottingham. Messrs. Abell, Boden, and Farey inspected it, and the bobbins sent with it. Weston said he had had it in his possession about five years. Taylor being in the rules of the Fleet was sent for, and stated "that the model was a similar one to that originally made by Whittaker for Hood and Taylor, but abandoned after a considerable outlay Charles Hood stating that it never could make lace and was useless, which opinion was indorsed by the judgment of several others from Nottingham. The model before them was made in 1811-12,

after Taylor's partnership with Hood had expired. Not being a mechanic, he could not say if lace could be made on it, but a coarse kind of lace had been made on it by *hand*." On Abell's telling Weston that this model being made after Heathcoat's patent had been taken out would be of no use in the cause, Taylor said "it was a pity they had not said it was made before, and they could make it a few years older, if material." Messrs. Boden and Farey corroborated this account of the interview, and Farey repeated the opinion he had expressed in 1815, that Taylor himself understood nothing of the capacity of Whittaker's machinery to make lace.

In the *History and Topography of Nottingham*, p. 84, the following passage occurs in relation to the efforts of inventors in that place about the beginning of the present century:

"Certain clever mechanics were exerting their ingenuity in an endeavour to improve the manufactures of fine lace, amongst whom Messrs. Lindley and Whittaker were very conspicuous. Whittaker was a shrewd man and had made many improvements in lace machines, but did not produce any very striking result; nor indeed were the experiments of Mr. Lindley much more successful, although he claims the merit of being the inventor of bobbins and carriages. The labours of both these gentlemen were however eclipsed by the efforts of Mr. Heathcoat, who produced a machine to work by using many of the bobbins and carriages, for which he obtained a patent in 1809. Upon this it was insinuated by certain individuals (perhaps envious ones) that Mr. Heathcoat had borrowed the inventions from Messrs. Lindley and Whittaker, and that instead of being the projector of the machine, he had merely embodied the ideas he had stolen from others. The credit of the invention is now however pretty generally allowed to Mr. Heathcoat, whose machine they called the 'Old Loughborough.'"

In addition to Lindley, Whittaker, and Hood, there were, it is said, twelve or thirteen other mechanics who spent several years partly or wholly in pursuit of a solution of the problem of forming mechanically a twisted and traversed web of lace. Several of these persons were men distinguished above the rest for their ingenuity and misfortunes. Two of them, Simpson and Green, died of disease of the brain brought on by unremitting and unrequited study. None of them could employ a bobbin and carriage so as to make the real net lace. So difficult is this that there is probably

no more instructive lesson in mechanics than to make the experiment, and then compare its results with the mode in which this was at last accomplished. So great was the mystery and such the number of abortive attempts which had been made during forty years to penetrate it, that the projectors were commonly ranked amongst enthusiasts seeking to obtain perpetual motion.

It was during the latter part of this series of efforts, that John Heathcoat entered upon and accomplished the task which had baffled so many other clever men. This successful mechanician therefore occupies a most important position in the manufacture of lace by machinery. Standing midway between the crowd of able men who, as inventors, preceded him about the close of the last and opening of the present century, and that numerous body of clever and useful mechanicians who have followed him down to the present time,—his invention restored and strengthened the foundations of the lace trade of Nottingham, decaying through the falling away of the manufacture of point net—and thus, by the substitution of bobbin net machinery, developing its productive powers, dispensing benefits to the neighbouring traders and work people, and by its rapid increase becoming an important branch of national industry.

CHAPTER XIV.

THE TRAVERSE BOBBIN NET MACHINE.—MR. JOHN HEATHCOAT.

Mr. Heathcoat was the son of Francis and Elizabeth Heathcoat. His mother's maiden name was Burton. His parents, it has been recently ascertained, were living at Duffield, near Derby, at the time of his birth, which took place on the 7th August, 1783. He had an elder brother Thomas, who was for many years before his death a large manufacturer of bobbin net at Barnstaple; and a sister, Anne, who was married to Mr. Thomas Hallam, in after life the director of Mr. Heathcoat's bobbin net manufactory at Paris and St. Quentin.

Mr. Heathcoat, sen., was a respectable small farmer of chiefly grazing land at Duffield. Mrs. Heathcoat was a managing housewife, of an affectionate disposition, and much beloved by her husband and children. Both were always esteemed for their real worth and amiable demeanour by their friends and neighbours. Soon after the birth of their youngest son, Mr. Heathcoat, sen. was stricken with total and permanent blindness. This great calamity disabled him from giving active personal attention to the business of his farm, which he therefore ceased to occupy, and removed about 1790 with his family to Long Whatton, near Loughborough—a circumstance which has given rise to the statement that his son John was born at the latter village. Throughout the remainder of his life, the latter part of which was passed in easy circumstances at Loughborough and prolonged to an advanced age, Mr. Heathcoat, sen. maintained much equanimity and cheerfulness of mind and temper, with pious submission under his afflicting deprivation. In this he was aided by the constant assiduity and loving care of his wife, shewn in her endeavours to alleviate his loss. He embarked some

John Heathcoat

money in the purchase of warp machinery, then employed in that district to some extent in the manufacture of woollen hosiery pieces. For the use of these frames the master stocking-makers paid a considerable rent to the owners, so that the sum derived from them was often a fair portion of the income of a family in moderate circumstances.

Their children received as good an education as a village school usually afforded at that time. John was taught at one of the neighbouring places, it is not quite certain which, but from the circumstance that he was remembered to have been seen when a youth proceeding towards Hathern daily with his satchel, or returning from that side, it is probable that he acquired the rudiments of knowledge there. Wherever taught, it is related on good authority that his quickness in learning greatly surprised his master. Scarcely was the task in arithmetic or grammar given, than the correct solution and answer was returned. He was also distinguished for his thoughtful intelligence and quiet manner. He began to read as opportunity offered, and having few companions either to hinder or assist, he studied hard, acquiring and storing facts in history and science—afterwards to be used by him with surprising accuracy. His earliest letters and correct habit of speaking shewed his accurate knowledge of English grammar and composition.

It is stated by one of his relatives that Mr. Heathcoat was apprenticed to a Mr. Swift to learn the hosiery manufacture, but that the place not being found eligible for his son, Mr. Heathcoat, sen. by payment of a sum of money obtained the cancelment of his indentures.

Several other accounts agree that he was apprenticed to Mr. William Shepherd, a maker of Derby ribbed stockings and frame-smith then living at Long Whatton, and who became afterwards connected by marriage with Mr. Thomas Heathcoat. This second apprenticeship was no doubt entered upon immediately after the first was set aside. Some have supposed he was an apprentice to Mr. Samuel Caldwell, of Hathern. This is an error, as their connection began during his sojourn at Nottingham.

It is certain that Heathcoat learnt to handle tools with dexterity at an unusually early age, and acquired an exact knowledge of the stocking-frame and the more intricate warp loom. It is even asserted, by one who had his confidence, that he had at sixteen conceived the thought of inventing a machine to make lace. Of this, more will be said in its place from his own lips long after that idea was realized. Writing on the subject he says, "I was working for my bread; I tried to invent;" and during his apprenticeship he succeeded in improving some part of the warp frame. There is also no question but that Mr. Heathcoat early felt the necessity for self-help and self-culture, and set his whole faculties to work accordingly. It is evident that when but a youth, he thoughtfully weighed and cheerfully accepted the responsibilities attendant on his station in life, and prepared to meet them. He ever felt the necessity of reliance on himself; and thus, a few years afterwards, when appealing to the equitable judgment of the Lord Chancellor for protection against infringers on his patent, he says, "I had originally no property, and have risen entirely by my own ingenuity and industry."

It was during the latter years of his apprenticeship that the young inventor's duties required his frequent visits to Kegworth. At that large village there was a schoolmaster named Wootton, who taught for years many boys living in and near the place. In his school the author received valuable instruction, for which he reveres his excellent master's memory. Through various circumstances the schoolmaster and Mr. Heathcoat became acquainted by their intercourse with mutual friends. Thus far is known. Whether any closer intimacy sprung up is not certain; but from some characteristics common to them both that is probable. The schoolmaster was self-taught having learnt his alphabet from the gravestones in the churchyard, and was never at school for a day; yet he became an excellent English scholar, an algebraist, a land surveyor, an astronomer, and a mechanician; and was a noble-hearted man. He would not destroy the life of an insect or of a worm; therefore ate no animal food, and his drink was water. But it was an orrery of his own construction that was the admira-

tion of his pupils and neighbours. It never occurred to the author in after years to ask Mr. Heathcoat as to the extent of their communications with each other; but in the quiet unpretending science and mechanical skill, the high principle and kindly disposition of Wootton, there seemed answering traits and sympathies in Heathcoat that appeared near akin, and might, if developed by friendly intercourse, have assisted to strengthen the higher thoughts and incentives in the struggle of life, which animated the young aspirant after mechanical success and reward.

While all the other persons described as applying themselves to lace inventions, appear to have had one or two partners in the prosecution of their experiments, Heathcoat, from the time he entered upon this career, seems to have planned and executed his schemes alone, having neither counsellor nor co-worker in them. His first step on the conclusion of his apprenticeship was to seek work at Nottingham as a framesmith and setter-up of machines. There the most difficult and best paid work was constantly on hand, and consequently, he would find himself among those mechanics in the hosiery and lace trades who were of the highest skill and reputation in both businesses. He entered into the employment of Leonard Elliott, a man of superior skill and well known in the trade, whose shop was situated between Broad Street and Beck Lane, and continued to work with him for some time as a journeyman. At first he received 25*s.* weekly earnings; but in a few weeks he was found worth and received three guineas a-week. Mr. John Farmer, of Nottingham, then himself a working framesmith, recollects often seeing Mr. Heathcoat at work wearing his white apron in this shop. There he could not help daily hearing more or less talk, acquainting him with the sanguine hopes of the local mechanics in regard to lace machinery being made to imitate real pillow productions. Elliott related to the author, in 1849, that "Heathcoat had been brought up chiefly in setting up coarse hosiery frames of each kind. He was himself mostly employed in setting up fine warp frames. Heathcoat had obtained a thorough practical knowledge of mechanical powers and contrivances;

was inventive, persevering, undaunted by difficulty or mistakes, and consequent temporary want of success; patient, self-denying, and very taciturn. But he had surprising confidence, that by right application of mechanical principles to the construction of even a bobbin net machine, his efforts would be crowned eventually with success." To this object he gave unremitting attention during every hour of leisure that he could command. After a short continuance in the service of Elliott, he purchased from him the tools and goodwill of the business, and carried it on upon his own account. While Heathcoat was thus engaged in the occupation of making new and repairing other stocking and warp looms, he won the approbation and respect of those who gave him employment, by his talent for invention, general intelligence, and the sound and sober principles that governed his conduct. He thus obtained the highest remuneration that the business of setter-up would at that time allow. By these means he appears also to have obtained the confidence and respect of intelligent and observant artizans around him, while he was realizing funds to enable him to prosecute the experiments he had now entered upon.

It was during this period, and soon after Mr. Heathcoat had attained the age of twenty-one, that he became acquainted with, and married, Ann, the daughter of Mr. William Caldwell, of Hathern. She was a widow, and somewhat older than himself. They resided while at Nottingham, in a house on the Long Stairs, since taken down. Mrs. Heathcoat was an active, thoughtful, and clear-minded woman, and always shewed great simplicity of mind and taste. She was a notable manager and an excellent wife and mother: doing honour to her husband's choice in the guidance through very varied circumstances of her family and household. There never appeared in her any wish to forget her former station, or the early labours and trials of her life. On the contrary, upon suitable occasions, she would refer to them with becoming expressions of gratitude; and being endowed with much practical good sense, adapted herself without difficulty to the growing elevation of her position in society.

The Mr. William Caldwell, just named, was originally a Derby-ribbed stocking-weaver, but he became an excellent framesmith and a setter-up of some note at Hathern. Mr. Heathcoat's marriage with his daughter and connexion in a mechanical patent with his son, Samuel Caldwell, had some beneficial influence in his rapid progress as a mechanician, and probably led him to give up the promising business in which he had so recently embarked, and his residence in Nottingham. He had now fully determined to enter upon the course of invention on which his thoughts had so long dwelt, and although proximity to the skill existing in Nottingham might have its advantages, yet to depend on his own at some distance, would be more safe in the process of completing his contemplated invention. He therefore decided to remove for a time to Hathern, to which step he was also moved by the following circumstance.

For some years the wife of one Thomas Hancock, a journeyman to Caldwell, being a Northamptonshire woman, knowing how to make lace upon the cushion, and having the bobbins and parchments used by her in that kind of hand labour, employed herself in making lace. Heathcoat saw her at work from time to time, and acquainted himself fully with the manner of proceeding in this beautiful but intricate art. The knowledge thus acquired he was not slow in putting to use, as we shall see in his own account of the progress of his two next and most important inventions.

It has been already mentioned that Mr. Heathcoat's first improvement in machinery was patented by "Samuel Caldwell, of Hathern, Leicestershire, framesmith, and John Heathcoat, late of Nottingham, now of Hathern, frame setter-up." The patent was taken out in 1804, No. 2788, and was "for a new apparatus to be attached to warp frames, whereby all kinds of thread lace and mitts of a lacy description may be made." Several improvements were set forth in it:—

First, to place layers of flannel on the warp beam at intervals while filling it, and so to keep it soft and preserve the elasticity of the thread. Second, to make the needles more square at the hook heads, and so to admit the passage of knots in the thread without

breaking it. But principally, third, by putting on an extra guide bar and breaking out guides at intervals, and employing there the separate guides; where breadths required dividing, a lacing thread was worked in, which only required to be withdrawn, and a clear and neat pearl selvage was left on each of the edges of the breadths. For accomplishing this, a division presser, and an instrument called from its use a preventer, were added to the warp frame. In work there was a common course made and then a lapping course, usually followed by a connection course and another lapping course. According to the intended mesh there were two or three lapping courses made.

The contemplated results were found to have been anticipated by a previous invention, of which they had not heard.

In 1805, Caldwell took out a patent, No. 2879, in his own name only for a machine to be added to stocking and other plain frames. Immediately before the date of the former joint patent, Mr. Heathcoat had removed his residence to Hathern. Either on his father's account or his own he became connected with Mr. Jelbert, an attorney at Kegworth, in some warp machinery, and for a time was often at the latter place. The untimely death of this gentleman put an end to that business. Jelbert did not advance funds towards prosecuting the experiments for making a twist machine. These occupied a period of about three years, commencing 1805, for in that year one John Bailey, a frame-smith, conversant with the warp machine states, he entered Mr. Heathcoat's service as a setter-up of warp frames, and became an inmate of his family, then transferred to Loughborough.

This Bailey gave, in 1813, a clear written statement of some important circumstances which transpired under his own eye. This possesses considerable interest in tracing the course of the inventions contained in the two first bobbin net patents. It appears that Bailey first met Edward Whittaker, to whom considerable reference has already been made, at Charles Hood's, both living at Loughborough in 1805, and Hood was then in business as a frame-smith there, but not acquainted with Heathcoat. Hood informed Bailey in 1808 that Whittaker had endeavoured to make a lace machine, but after several trials could not succeed, which had induced him to advise Taylor and Hood to give Whittaker up. On Bailey informing him of this attempt of Whittaker's,

Heathcoat shewed Bailey lace that he had already made upon his own first frame. Parts of this machine the workmen had seen, and knew they were not belonging to their warp machinery, but on seeing, in January, 1808, the completed machine which their employer first patented, the mystery was cleared up. Heathcoat had sometimes expressed wonder if ever Buckinghamshire lace would be produced by machinery, and Bailey thought it impossible, as warp machines on which they were then engaged required twenty threads to an inch, whereas pillow lace must have double that number, besides allowing the necessary space for twisting the threads.

Till 1808, Bailey had not seen the machine, only the lace from the model. Now he was taken from warp frames and set to work on the new inventions for the second patent frame, and made many parts of them. The first patent frame made narrow breadths and required great width for the expansion of the threads. The construction of the second for wide nets was attended by great difficulties, as the machines differ altogether, except in the points and work-beam. When he began to assist, Heathcoat had laid aside the first machine and begun the second.

Charles Hood had continued his attempts to construct a twist net machine for two or three years; but it was Bailey's conviction, that during that time no communication had passed between him and Heathcoat. But when the latter had joined Lacey in 1808, then Hood entered into their employ as a frame-smith.

After this, by Heathcoat's desire, Bailey and one Johnson (since dead) inspected Whittaker's machinery, consisting of some bobbins and two bars, which they were of opinion could not have produced lace of any sort. Charles Hood then shewed them a machine, said to be of his own construction, and the one on which a piece of lace previously shewn had been made. There had been only one set of threads used, which were longitudinal, and in passing each other they were merely twisted once; so that being made only of threads travelling straight down, if one were withdrawn, the net would divide; it could not possibly traverse. Charles Hood at first used bobbins; but when Bailey

saw it, he was using small bits of tin to which the threads were tied, which plan he said he preferred.

In January, 1808, when Bailey saw the first patented machine, there was a skeleton model of the second, including the comb-bars, but no bobbins. From the construction of the parts, Heathcoat must have intended to use bobbins.

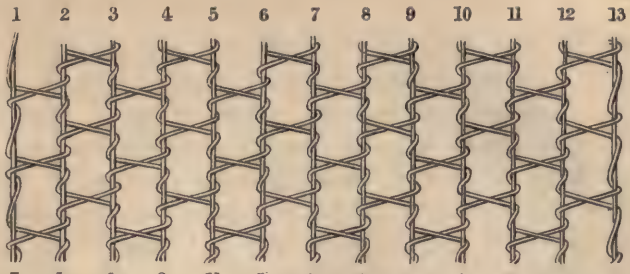
Heathcoat bought Charles Hood's tools after the bobbins for the second patent frame had been provided; and Bailey had no reason to believe that he had any knowledge of either Whittaker or Hood's bobbins to help him to construct his machine. There was no such alteration in it as to indicate that he had benefitted by seeing it in the construction of his own. Charles Hood told Bailey he received 30*s*. for Whittaker's portion, and £5 for his own. These sums were their value as old materials. Both Hood and Bailey stated, that Heathcoat never showed any anxiety to possess Whittaker or Hood's machinery; but they asserted that Hood's necessities were the sole cause of their being offered to, and so far as they knew, of their being purchased by him. He did not hesitate to express his regret in after years that he had bought them, as it proved a needless complication of the question, which arose in regard to his second bobbin net patent.

The various operations of the workers in hand lace have been described in a former chapter.

This process of making lace on the pillow is a very slow one; on an average about five meshes in a minute can be produced, where the usual number of twists are given. This may easily be conceived, by noticing that every cross and each twisting of two threads and the shifting of each pin are so many distinct movements of the hands. It is evident, therefore, that a machine having the means of acting upon every pair of threads throughout the breadth of lace desired to be made, for the purpose of crossing and twisting, and also to give motion to the pins to be successively placed in the new meshes throughout this entire breadth, would greatly increase the speed and facilitate the production of such lace.

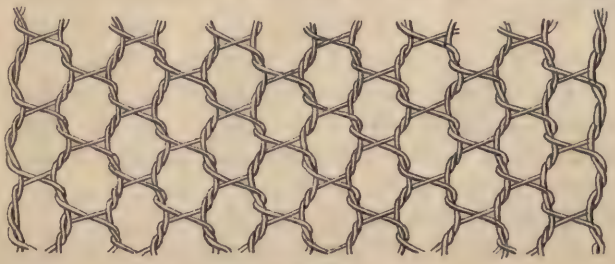
On examining cushion-made lace, half the threads

Fig. 1



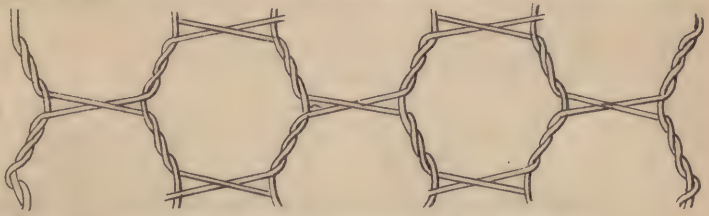
Two Twist Bobbin Net when making, shewing the diagonal traversing of bobbin or weft threads.

Fig. 2



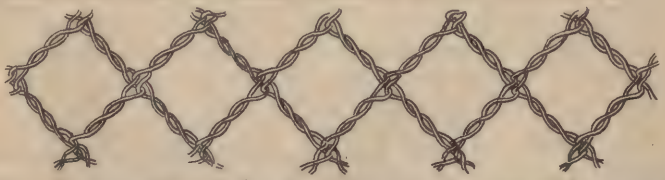
Two Twist Bobbin Net when taken off the Machine.

Fig. 3



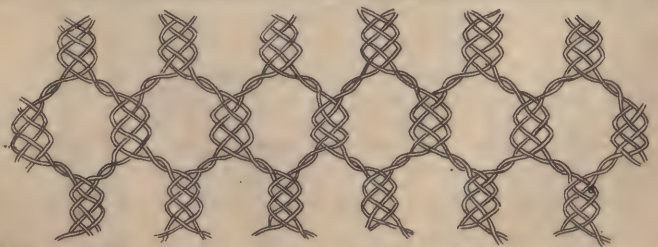
Three Twist untraversed called when traversed Brussels Net.

Fig. 4



Four Twist untraversed called Square Net, it is not crossed but platted at the corner of mesh.

Fig. 5.



Called Platted Net. - having platted four thread pillars and four sides each of two theads twisted, but not traversed.

W. Metcalfe. Litho Cambridge.

are found to proceed in wavy lines from end to end of the piece, which may be called *warp* threads. The other threads lying between the former pass from side to side by an oblique course to the right and left, and may be called *weft* threads. The inventor of the machine to produce the same results, considered that if he could place the warp-threads in it under such circumstances as that they should be all capable of moving either absolutely, or relatively with regard to the other threads, so as to concur in effecting the twisting and separation or crossing before described, but without deviating otherwise either to the left or the right; and that if he could also place the weft-threads so that they should effect the twisting by similar motions at the same time, that half these weft-threads should proceed at each operation to the left, and the other half to the right-hand (a substitute being also found for the pins), he would make lace exactly as it is done on the cushion, but with many advantages as to speed and cost.

Heathcoat's first plan, patented in 1808, No. 3151, effected this for the first time by machinery, so far as *traversed* bobbin net is in question. It was accomplished upon a machine whose parts and operations may be thus described: There were two beams, the one placed under the other in the same perpendicular line. Also threads divided into two sets, one of which was intended to work longitudinally, the other diagonally. The longitudinal set were wound upon the lower beam and were passed to the upper beam to which they were separately attached, and on which the work was wound up. The diagonal threads were wound upon bobbins resembling in the part occupied by the thread those used in making lace by hand. These bobbins were so arranged between the beams, that their threads proceeded collaterally with the longitudinal threads to the upper beam, and were inserted in the same points on the beam. Each of the longitudinal threads on its way to the upper beam passed through a conical tube, at the lower end of which was a small pinion. The upper part of the tube divided into two parts, cut in the direction of its length; one part contained the pinion at one end of it, and the longitudinal thread which passed through its hollow parts. The other section contained the bobbin on which the diagonal thread was wound. When the two sections were put together, the whole consisted of a conical tube having a pinion at its lower extremity, and containing a longitudinal and a diagonal thread. The number of these tubes was equal to the number of each kind of thread. Their arrangement was such that all the pinions lay in the circumference of a circle, while the centres of the other ends of the tubes pointed to its centre. All the pinions could be moved round at once by rack work, the teeth of which cor-

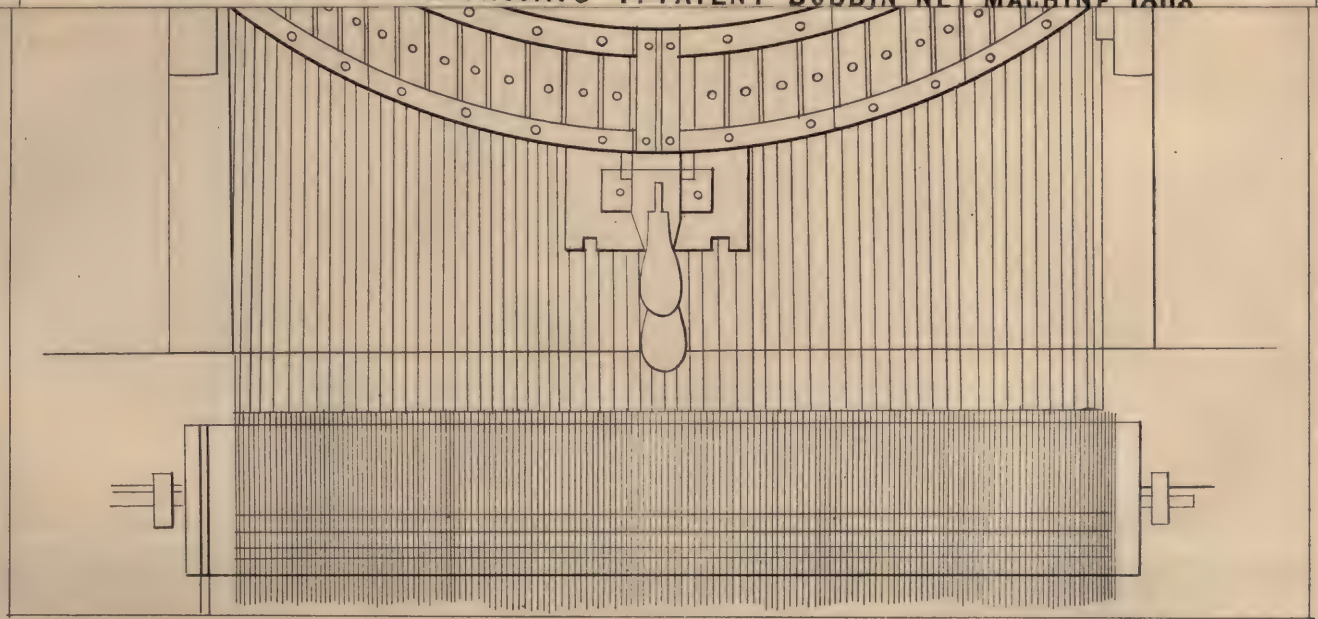
responded with the pinions. This motion was to cause each pair of threads contained in each tube to twist at the same time. The crossing of the diagonal threads as observed in the process by hand, was performed in the whole breadth at once as follows:—that part of the tube which contained the diagonal threads would be removed from the rest, and the whole of these parts would be lifted up together; while they were in this position, one half of them were caused to move one place to the right and the other one place to the left; and as each section of one would fit any of the others, when the lifted parts were let down again, each tube would have changed its diagonal thread, which would effect the crossing of these threads throughout. The pins by which the uniformity of the meshes was preserved, were all placed upon a moveable bar, and could all be inserted at once. Thus the crossings were first made by one motion, which interchanged the bobbins containing the diagonal threads.

The twisting was next performed by the revolution of the tubes containing the two threads to be twisted. The pins were then all shifted at once to regulate the new meshes formed by the crossing and twisting. As a whole, this was undoubtedly an entirely new compound instrument.

This machine was calculated to make one such breadth of lace as is usually made on the cushion (which seldom exceeds three inches) and with all the expedition possible. In order to obtain pieces of cushion lace of greater breadth, the narrow pieces would be joined together by the needle. It was desirable therefore to devise the means whereby pieces of the full breadth required might be made, and so avoid the expence and unsightly effect of joinings. Upon the completion and setting fairly to work next year, 1809, of Heathcoat's second patented bobbin traverse machine, the first was at once disused; and except in the specification and drawings, no means remain of obtaining a competent idea of what it was like, as Mr. Heathcoat did not preserve one at Tiverton—a singular oversight now much to be regretted. To supply the means of forming a general idea of its construction, a drawing of this machine is given in Plate V.

In regard to various important discoveries and inventions in other departments of business, there has been reason to regret that little or no authentic information has been forthcoming of their origin, and the early steps taken to bring them into practical operation. The following papers written down at the times and under the circumstances stated, will therefore be read with interest; Mr. Heathcoat having been requested, without

FRONT VIEW OF HEATHCOAT'S 1ST PATENT BOBBIN NET MACHINE 1808



W. Metcalfe Litho Cambridge.

previous notice or premeditation in either instance, to narrate the facts:

"Some particulars of the invention of the bobbin net machines, patented, No. 3151 in 1808, and No. 3216 in 1809 by John Heathcoat, esq., as stated by him, 18th June, 1836, to Mr. T. R. Sewell and Mr. William Felkin. (Taken down in short hand by the latter while Mr. Heathcoat was speaking.)

"When I was a boy at Long Whatton, in Leicestershire, with my mother, a girl used to come in to see her, whose cousin had been employed at the factory of one Dawson, in London, whom she described as having made a fortune by making lace upon machinery. On one of these calls this girl turned round to me and said, jocularly, 'Why can't you do so too, John?' This fixed my attention so much, that although it occurred forty years ago, it returns to my recollection even now. I do not mean to attach too great importance to this incident, yet no doubt it had an influence in the direction of my thoughts and energies at a future period of life. Point net was then made, and the lace trade excited some interest. About the time I grew up towards manhood, warp piece goods (not lace) were also beginning to be made. I worked for my bread, and I tried to invent. I did so by finding out a different mode of carrying the thread in the warp machine to what was in ordinary use, viz. passing the thread over the needles on which the loops had been formed immediately above the threads, and also over the next needle, so as to form a kind of lace. But I soon learnt that this had been discovered before, though I had then no knowledge of it. The first warp machines were making 'Berlin,' and the person with whom I then worked altered one to make 'mitts' of a lacy appearance, and approaching the lace fabric. A man about that time made four and six course warp. For a time it was supposed by many that the difference between pillow and machine lace was solely in the material used; but every body soon knew that they were unlike in some other respects, and it was ascertained that the texture was different. I set to work to inform myself in what the peculiarity in the texture of pillow lace consisted, and for this purpose obtained a sight of the process of making it. A pretty heap of chaotic materials I found it! Like peas in a frying-pan dancing about. After watching the progress of the workwoman and minutely examining the lace, I found much difficulty from the circumstance that a thread which had been carried for a time lengthwise, sometimes became a traversing one, and *vice versâ*. It was impossible under the natural supposition that this was a part of the system, and not as it really was, an irregularity, for me at first to trace the course of the threads so as to understand their ordinary and regular progress. At length I made out that one part were passed to the right-hand, another to the left, and a third seemed to be independent of them, never deviating in their course, but always passing straight through the length of the piece. This part of the threads I saw might be put on a beam for a warp; and it was this discovery that simplified my subsequent progress in attempting to mechanize the processes of the pillow.

"In my *first* attempt mechanically to make bobbin lace, the bobbins were arranged in a fan-like order on pinions, and thus

radiating they were made to twist round each other, and a row of pins forced up the crossing to close the mesh. These pins were fixed on a bar, but they spread out and contracted; lying between guides, they expanded on receding, and contracted when brought in contact with the work forcing up the twist and the crossing, until the meshes became of the right size and shape. By this arrangement and process, only very narrow strips could be made. However I constructed a machine to produce three such pieces at a time. Lord Lyndhurst, then Serjeant Copley, always said that this machine was far the most ingenious of any upon which lace was ever made.

"The value of lace is however so much enhanced by its being made of greater width, that I was determined to make it even a yard wide. At this time I had arrived at the important point, that having actually made lace as above described, I had satisfied myself my principles were sound and well based. But I now clearly found out that while half the threads must be active, the other half might be passive, and I therefore put the latter on a beam. Having thus fixed the warp, to accomplish my wish for making wider lace, I tried to bring the threads to twist in a narrower compass. I first tried a machine with the bobbins spread out; then I tried the *flat* bobbin. The first flat bobbin machine was a *single tier*. I carried up the threads by means of a steeple top on the carriage. Great difficulty was experienced in getting bobbins and carriages thin enough, the space in which they were to move being so limited. At last, I was driven to the *double tier*, and thus obtained the requisite space.

"All that I knew of previous attempts, and all that I now believe had ever been previously done, was this. Moore had by mechanical means and arrangements obtained a twist on both sides, by carrying threads over each other and then back again. I did not then know of this plan, it came to my knowledge afterwards. Whittaker made a machine in which were eight or ten threads to an inch, (and as he said) producing an article having wavy lines like blonde in effect and made entirely by the use of bobbins; but the implication in Ure's statement, that Whittaker had made thin bobbins to gain the space necessary for them to pass, is not true. His comb bar was like the jack bar of a stocking-frame, and in several respects the machine presented impossibilities for making lace. In some cases ten times too much thread would have been given off from the bobbins.

"Charles Hood's tools having been offered me for purchase, and himself desiring work as a smith, I bought them of him. On looking over these tools I found amongst them a bar resembling the jack bar of a stocking-frame. He told me that Whittaker had shown him a bit of lace said to have been made upon a machine, but which Hood stated he had ascertained was not, but was most probably made by hand. Hood asserted that lace had never been made upon Whittaker's machine, and I saw that it never could. Hood tried however to modify the machine, hoping to accomplish this end. He laid aside the bobbins, and used plates of iron to which the threads were tied; and by alternate movements he made lace; but it was like Moore's lace, it had no *traverse*. The lace was made on a horizontal plane, at one end he carried up his twist by bits of wood, which passed between the threads and drove up a twist and the crossing at the same time perhaps the space of two yards. These attempts of Whittaker and Hood were decidedly the only things of which I knew before my

patent, in which there was any approach towards making *twist* or bobbin net lace. The one had tried to make it all by bobbins, but never did nor ever could by his machine thus make it; the other made lace, but not bobbin net lace. But before then, nor to this day, have I ever heard of any one besides myself, who had entertained the idea of separating the threads, placing part in a *warp*, and using the remainder in *bobbins*, and thus making lace.

"The stocking-frame has certain parts used in my bobbin net machine; the point net frame, the warp machine, the Vaucanson loom, even the old weaving loom, and many others, have all one or more of those mechanical principles or arrangements used in my machine. I do not claim the invention of a bobbin itself; but I had great difficulties to surmount in getting one thin enough. The foundation of my invention was in getting rid of half the threads by the warp beam; but then came the enquiry how the rest were to be got to twist in the proper space. Were this now to be done, my impression is that so great was the difficulty, I should not attempt its accomplishment.

"I admit the merits of other men. Brown's with his shuttle for the fishing net machine, or Whittaker's for his bobbin. Brown's machine I never saw; his specification I had a knowledge of. I had also a knowledge of certain parts of Whittaker's. I allow them the credit of their materials; I took up their crude materials, and I claim all that is intermediate between these materials and the bobbin net machine. My claim will be allowed I am persuaded by the suffrage of every man competent to form a judgment of mechanical inventions. Is it just to deprive me of all claim to invention in this matter, while it is accorded to each of those who have followed me in respect of their modifications? For there is not any new principle involved in any of their arrangements; they have all worked upon my principles of dividing warp and bobbin threads, twisting, and crossing; and the machine, however modified, is still the same as my 'Old Loughborough' in every essential principle. I allow them credit for the application of great and very useful ingenuity; but they have only *modified* the machine, not *invented* it. I illustrate the case thus:—A child in his first successful effort to walk across a room does all in fact that a man does—neither so safely, so rapidly, or so well; but every element of locomotive power is there, and every muscle is in action; he walks as truly as a man."

These concluding observations were made by Mr. Heathcoat in consequence of a reference made that forenoon to Dr. Ure's statements in his *History of the Cotton Manufactures*, vol. II. pp. 342, &c., the substance of which has been given at p. 160, in describing Robert Brown's patent. And also because Ure speaks of Morley, Levers, John Brown, Sewell, and others, as 'Inventors,' in regard to the altered and for the most part improved machines known by their names, but has withheld that title in regard to Heathcoat, although he had allowed that:

"To him belongs the distinguished honour of solving the very difficult problem, and of practically demonstrating that a machine might be made to satisfy the wants and wishes of the trade. His first operative scheme was the result of many troublesome trials, which would have baffled a man of ordinary talent and enterprize. At length, in 1809, he had so far matured his plans as to warrant his securing their exclusive use by a patent famous for its pecuniary productions, and for its being the fruitful parent of many mechanical constructions eminently subservient to the trade and commerce of the kingdom."

Mr. Heathcoat and Mr. Sewell afterwards examined Brown's fishing net patent together at the Petty Bag Office, on the morning of this conversation, the author being with them; and Mr. Sewell on his return to Nottingham remarked to the latter, on the subject of Dr. Ure's and Mr. Heathcoat's statements—

"That if a machine to make nets by the use of bobbins be a 'bobbin net machine,' Robert Brown's may be called one; but that it possesses nothing whatever to entitle it to be called a 'bobbin net *lace* machine,' or a '*twist* machine.' With the exception of a thin bobbin inserted into a slit made in a piece of iron to receive it, it does not possess any of the essential principles or arrangements of the bobbin net or *twist lace* machine, which Mr. Heathcoat claims to have invented; and the introduction of which lies at the foundation of what is called the 'bobbin net lace trade.' The twisting of the threads is nowhere described in Robert Brown's specification; nor is the machine, as specified by him, calculated to accomplish this purpose."

In the year 1844, being on a visit to Mr. Heathcoat in London, and having some reason to fear the former statement, made in 1836, which was mislaid might be really lost, he was requested to give the opportunity for the facts to be secured, by stating them afresh to me. As he spoke they were written down; not only is the statement corroborative, it also gives supplementary matter of considerable interest. It is therefore copied from the original MS.:

"Amongst the earliest things which engaged my attention in regard to lace, was to ascertain its composition by obtaining a piece of *pillow* lace. I drew a thread, which happened to draw for an inch or two longitudinally straight, then started off diagonally. The next drew out straight. Then others drew out in various directions. Out of four threads concurring to make a mesh, two passed one way, the third another, the fourth another still. But at length I found they were in fact used in an orderly manner. This process was to answer the question in my own mind, Can this be made mechanically?

"I then saw a woman working on a pillow with so many bobbins that it seemed altogether a maze. However I at length perceived, that after certain twisting of two for instance one round the other, and then other two the one round the other, then one of each of

these pairs was selected, and they were then made to change places forming a cross, which cross was taken up by a pin, the pin being secured by a hole in the parchment placed to receive it. The twisting was then resumed between the changed and the unchanged bobbin in regard to each of the two pairs of thread. By this process there would be formed the last half of one mesh, and the crossing between that and the next, and the first half of the succeeding mesh. Now that which at first appeared to be an unmanageable and complicated mass of dependent bobbins, by process of observation resolved themselves into two great classes; those, namely, which by the workwoman were twisted with the others, yet always retained their position to them relatively in a longitudinal direction; and those which having been used in the process of twisting round the former, travelled the one part to the right, the other to the left, in the case of the formation of the crosses, constituting the top and bottom of the meshes. The result of this observation was to make this impression on my mind, that although for the making of lace on a pillow, this great division into two parts of the threads and bobbins might not be useful, yet if ever lace were made on a machine, it was quite possible to take the one half out of the dependent and mixed up condition I saw them in on the pillow, and place them upon a beam, making the twist solely by the rotation of the other threads in the passing them round these thus placed. Having got to this point, I took pack-thread and put upon a sort of frame, so as to be fixtures, that portion which I saw were to perform the office of longitudinal threads; a like number, constituting the other half of the threads, I put each on a sort of bobbin, so as to be disposable and transferable into the positions necessary to perform the two operations of making the crosses by changing places with each other, and forming the twists with those lengthwise, by being passed round them the proper number of times. Thus a succession of these operations produced a number of meshes, of a like construction with those I had witnessed made on the pillow by the female referred to.

"My first ideas of the application of machinery to this process therefore followed these processes of the pillow, with the modification of withdrawing half the threads and placing them upon a beam, and making all the evolutions solely by the use of the other threads which I placed upon bobbins.

"As to making lace of ordinary fineness, forty threads being requisite in each inch in width of lace, though I had got rid of twenty of these, I still required twenty bobbins to make an inch in width; these bobbins being similar in shape and principle to those used in pillow operations, the space they occupied in the machine I now projected and proceeded to construct, was much more than the width of the inch of lace when formed, consequently they radiated towards the point of formation, and I soon found the difficulty arising from the outer bobbins giving off too much thread, placed as they at first were in this straight line. I was compelled therefore to place them in a segment of a circle, so as that each bobbin might be at exactly the same distance from the meshes as the others, in whatever part the traverses required to form the net might place them. This circular arrangement of the bobbin threads, so as to give them equal tension during every part of the processes, has been adopted in the

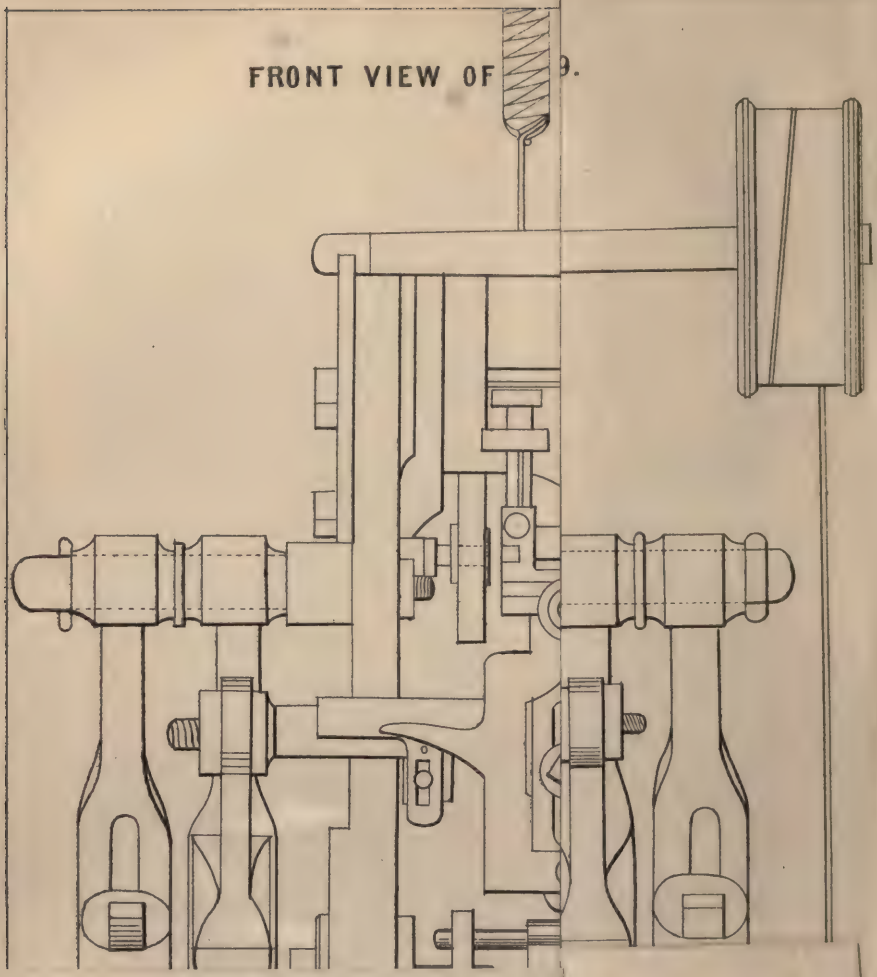
original machine, and, with one exception, which has long since ceased to be used, in every modification of it until the present time. The arrangements ever since used by which the bobbin threads were made to twist, to traverse, and to close the mesh, have been in principle the same as those specified in my patents of 1808 and 1809.

"This first machine may be considered as a mechanical pillow; (see Plate V.) but while half the threads were on a warp roller beam and half on bobbins, and the crosses carrying before them the twists, were forced up by a row of pins placed on a bar to the work roller above, each operation was performed along the line of threads at once. The twist, the crossing, the traversing, and at length the whole line of meshes across the machine, were each one in succession performed and finished together.

"I consider that this my first bobbin net patent machine did for the making of lace in relation to the pillow, what the jenny did for the spinning of yarns in relation to the old long wheel. The processes were in principle the same, in the jenny as in the mode of spinning upon the long wheel, mechanically performed in the drawing out, twisting, and winding upon a cop, of a number of threads at once instead of one. This lace machine not only however performed the consecutive operations necessary for the formation of one such mesh in relation to many meshes, but required and secured the adoption of certain principles of selection and division, to be applied to a vast mass of hitherto very complicated materials, and that presented practical mechanical difficulties which I found to be of no ordinary character. Two or three years of study and experiment were employed in overcoming them.

"Though highly spoken of by Lord Lyndhurst as to its mechanical construction, yet for practical purposes this first machine was superseded by the one which was the subject of the second patent, 1809. Lace of an inch or so in width, made upon the first patent plan, was inserted in a child's cap, worn and washed to test its capacity of resistance. It was taken to Mr. Lacy, asked to be left, and was sent to London. Mr. Lacy in company with Mr. James Fisher saw me at Nottingham, or at Loughborough, where these experiments had been carried on. I was asked what width I could make it, if more than an inch or two. I had not thought of this as a thing to be desired, but said I thought I could bring my bobbins within the width of the lace, and if so I could go any width. This gave my thoughts a new direction. The division into warp and bobbins became more important than ever. Setting to work to get the bobbins into the space of the lace to be made, brought me to adopt the thin or flat bobbin instead of the round one. The next point made was to put the warp into the exact width of the lace also. My plan being for a single tier, the bobbins and carriages were put in this single row, and past altogether through the movements from side to side of the machine, then were divided for the crossings, then reunited to repeat the former motions. But the difficulty of obtaining at Loughborough well-made bobbins and carriages, the latter being very long in order to form the twist as near the work as possible, led me to attempt dividing the carriages and bobbins into two rows or sets, so as to perform their functions respectively, without periodical separation, and at once to relieve myself, by being enabled to use a bobbin and carriage twice the thickness of those previously employed. See Plates VI. and VII.

FRONT VIEW OF 9.



"In thus bringing the second patented machine, called from the place where its construction was finally accomplished, "the double tier *Old Loughborough*," the mental labour was very great. When puzzled and fatigued by endeavouring to overcome difficulties (which often occurred), I was enabled to exercise the happy faculty of entirely quitting the subject, and by reading or other occupation of the mind to refresh it."

Mr. Heathcoat we find has described to more than one of his other friends, that when he had decided to lay aside the first patented machine, on which indeed he had made but little net and of course received but trifling returns, he began his experiments with a view to the second by suspending common pack threads from a beam placed aloft across the room for warp threads; then he passed the weft threads by common plyers, delivering them to other plyers on the other side, and after giving them a sideways motion, the threads were repassed back between the adjoining cords, receiving by this a twist, and the meshes were then ready to be closed by hand as upon the pillow. Here was the incipient movement between the warp threads of the future bobbins and carriages. The original drawings of the different coloured threads, beam, twistings, and crossings described above, are now in the author's possession.

Thus Heathcoat invented the second machine calculated to make lace of any breadth required, and for which he took out a patent, 14th July, 1809, No. 3216. In his specification he entitles it "a machine for the making and manufacturing of bobbin lace, or lace nearly resembling foreign lace, by which means such lace would be made to much greater advantage than by any other mode hitherto practised, and from the use of which would result a considerable decrease of expence, being calculated to promote an effectual saving in time and labour, which he conceived from repeated experiments would be productive of great public utility; that he was the first and true inventor thereof, and that the same had not been made or used by any other person or persons whatsoever to the best of his knowledge and belief."

This machine had two beams or rollers similar to those in his former one; but the bobbin apparatus was very different, so much so as to constitute an entirely new machine.

The pinions described in the first machine as placed at the ends of the conical tubes, necessarily occupied a great breadth when arranged laterally, compared with the breadth of the piece of lace. If, for instance, the diameter of one pinion were one-fourth of an inch, the mesh of the lace being sometimes one-sixteenth of an inch, the breadth of the bobbin apparatus would be as four to one, to the breadth of the lace. This would be exceedingly inconvenient in making broad pieces. The great extent to which the radiation of the bobbins expanded the area of the working in that part of the former machine, gave it the name of the *fantail*, by which it was generally known. There would also have been far too great friction to be overcome, arising from giving revolving motion to so many tubes.

This induced Mr. Heathcoat to make his bobbins so thin as that the whole number required should not occupy more space than the breadth of the piece of lace.

This bobbin, with the carriage in which it is placed for conveyance to and fro and from side to side of the machine, will be easily understood by the Figure 2, Plate IX. The bobbin (wheel) contains a certain space between its sides into which the diagonal thread is wound. The longitudinal threads are wound upon the lower beam, and being divided into two parts, each set composed of every other thread and kept apart on their way by passing through certain upright tubes or guides placed at equal distances from each other, in order to keep the threads laterally at equal distances. They then proceed to the upper beam to which they are tied. Each set of warp threads is capable of motion to the right and to the left. The bobbins are placed in a row between the two beams, so that their threads may arrange collaterally with those from the lower beam. In this situation two bars are placed to the front and two on the back of the threads reaching from one side of the rows of threads to the other, and equal in length to the whole breadth of the lace. These bars are each divided into a number of grooves (combs) running at right angles to their length. They are so placed in back and front of the threads, as to be in the circumference of a circle. When the carriages containing the bobbins are placed in the grooves, they are not only kept at equal distances laterally, but they can be made to move like so many clock pendulums oscillating along the grooves through the longitudinal or beam threads by levers called shifting bars, which hang in the centre of the circle in the circumference of which the grooved (comb) bars are placed. The bars are called conducting bars. By one of the shifting bars the bobbins are passed half-way through the threads, and received on the other side by another similar bar.

This being understood, it will easily be perceived how the twisting is managed. When the shifting bars have passed the bobbins which contain the diagonal threads through the longitudinal threads, the comb bar which receives them on the other side, has a lateral motion given to it, equal to the space between two threads. If then the bobbins be brought back on the contrary side of each longitudinal thread, each diagonal thread will have made one twist with a longitudinal thread. If now the front comb bar be moved laterally, till each bobbin stands opposite to the space from which it first started, and the threads be again passed through to the back and brought again to the front on the other side of each longitudinal thread, the threads will have been twice twisted.

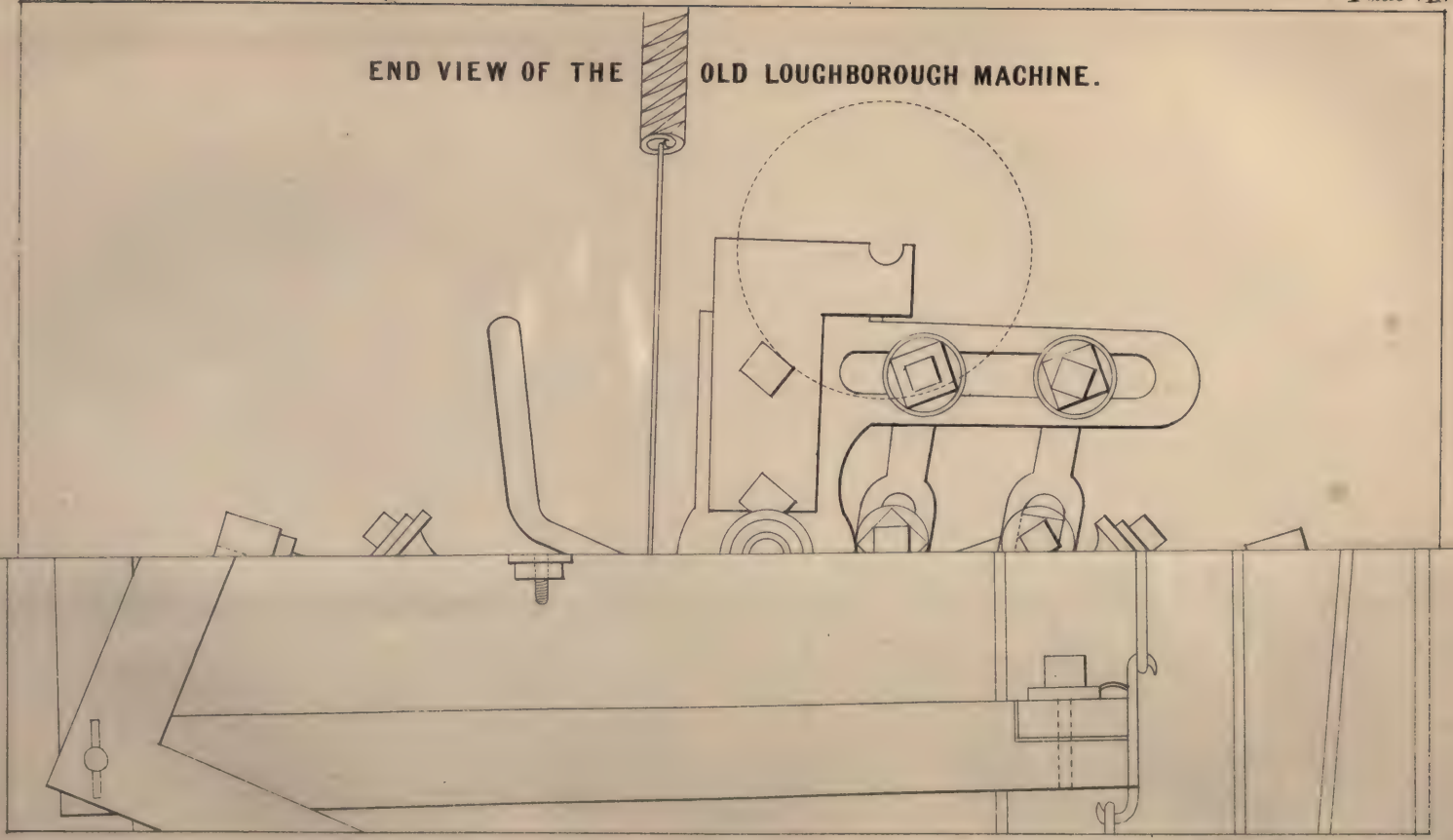
Previously to the twistings, one-half the diagonal threads must be moved to the right and the other half to the left, which has the effect of crossing these threads, and is brought about in this machine by a method as entirely different to that in the former machine, as the process of twisting differs in the two, and is as follows: A number of pins equal to the number of diagonal threads are placed in a bar at equal distances. This bar, called a point bar, is made to move backwards and forwards on an axis with pivots, by which means it can pass freely between the threads, and be withdrawn at pleasure. Previous to crossing, every other bobbin is so moved as to form one distinct row, and thus form two distinct rows of the whole; one row being a little behind the other. Then the points are made to enter the first row. They then receive a lateral movement, till the points are opposite to one division further to the left of the second row. The points are now advanced through the second row. The effect of this is, that the right side of the threads of the first row is in contact with the left side of each pin; while the left side of the second row of threads is contiguous to the right side of each pin, and the diagonal threads are crossed. This has prepared them for twisting with their contiguous longitudinal threads. There is another set of points which are in every operation used to relieve the first set. The first set have grooves in the upper side, lengthwise into these grooves the points of the second set are brought and occupy the place of the first which are thus released, and are employed in forming the new crosses in the subsequent operation. In forming the crosses as above described, the threads are crossed above and below the points. The lower cross is done away, by giving a lateral movement to each of the rows of bobbins in contrary directions.

In examining the specification and drawings of this machine, it will be observed that the number of bobbin threads, as well as the beam threads, are double to those spoken of in the above description. The difference is thus explained:—These double rows are placed one behind the other. If, however, the bobbins were of half the thickness, they might, with the same effect, stand in one row. The contrivance admits of the lace being made twice as fine as the thickness of the bobbin would seem to admit. In other words, the diameter of the mesh of the lace will be one half of what it would be, if one half only of each of the sets of threads were employed. One of the parts of this process distinguishing it from the previous attempts of Moore, Hood, and others, and that which gave the firmness and durability so important to its productions, was the traversing the diagonal threads from side to side of the net made by it. This, combined with the twists, prevented it from roving out, if one or more of the threads were broken;

and though effected by the first patent, yet may be described more clearly under this second patent. It is thus:—On the formation of every mesh, the diagonal bobbins and carriages moving to the right hand, will of necessity make the end of that row one carriage too many, and uneven at the right hand; and the left hand end one carriage too few. But the row moving to the left will have a reverse surplus carriage too much at one end, and too few at the other end of the row. By an ingenious contrivance, the machine makes a transfer of these carriages to the lacking end, back and front, and thus the full set is restored; and though each bobbin and carriage of the entire sets changes its place every series of meshes in width of the machine, the diagonal course is unbroken from end to end of the piece.

The following parts of Heathcoat's second patent machine are stated to be old. The warp beam and that on which the work is rolled when made, both being common to every weaver's loom. The wheel, brass, or bobbin, which, like the pirn in the weaver's shuttle, holds the weft thread, and which, it is said, had been used by Robert Brown, Whittaker, and Hood, and in a compressed form with a spring in the tape making machine for 100 years. The combs and comb bar in which the carriages holding the bobbins move or slide, and which are derived from the stocking-frame, and were claimed by Whittaker and Hood. The tube through which the warp threads are carried and regulated, and which are similar to those in warp frames. The points which carry up and close the work, and which are found in every lace frame except the warp; and the crank bars on which the point bars are suspended, and without which no machine of any kind can be worked. In Morris's patent of 1781, nearly all these parts were employed. Renouncing, if need be, the whole of them, it is confidently averred that no model or actual machine, or combination of these or any other parts of Heathcoat's machine, can be shewn to have been previously put together, upon which bobbin net, *twisted and traversed from side to side*, could be or ever had been made. The patent of 1808 is the first in which two systems of threads are arranged, the one longitudinal, the other

END VIEW OF THE OLD LOUGHBOROUGH MACHINE.



W. Metcalfe, Lithr. Cambridge.

diagonal, the latter traversing in two directions. That machine was a perfect one and very quick, but only capable of producing one narrow breadth of net. In the patent of 1809, on which the net can be made of any width, the warp beam and points are the only parts which were used similarly to the former invention. It was certainly a remarkable instance of decision of character displayed by Heathcoat, when after, by three years labour of mind and body, he had succeeded in devising and bringing into operation so beautiful a machine as that first patented by him, he should, without hesitation, have thrown it altogether aside upon perceiving its confined powers, though perfect as to its product; and at once set himself to invent one on an entirely different principle, and capable of increasing the production a thousand fold.

Having ascertained by what mechanical movements twisted and traversed bobbin net was first produced, so as to resemble perfectly the hexangular meshes of pillow net, it will be necessary to trace the course of the threads forming them by the aid of the figures on Plate IV., on which are shewn meshes of machine lace.

The upper and lower crossings lie in the direction of the piece so as to be at right angles to the selvage. Figure 1 will explain the crossing and intertwisting of the threads. It will be seen that of the three series, one proceeds longitudinally from above downwards; these are the warp threads which are extended from a lower roller to the upper work beam, usually in straight perpendicular rigid lines when in the machine. When the net is formed and taken off the beam, these warp threads assume a serpentine or winding path from the tension or draught of the obliquely disposed weft threads, by which they are alternately drawn to the right and left from the interlacement. If we suppose these longitudinal threads to be inflexible wires, the fabric would have the appearance represented in Figure 2, which indeed is the shape of the net as extended on the machine while it is in process of fabrication. Another of the series of threads runs to the right, and the third to the left, both of them in oblique zigzag directions. These two sets thus disposed wind round the up and down threads, and also cross each other in the intervals betwixt the warp, both travelling in a like manner but in opposite directions. These diagonal threads taking their course to the off-side borders of the web, towards which they are constantly tending, each bobbin thread as it arrives twines itself not once only as round the other warp threads, but a twist and a-half, the carriage remaining on the outer notch of the other comb, and turns back to twist and travel in the other direction. This last operation forms the selvages of the piece.

It is important to remark that the bobbin net machine is, in principle as we have described it, capable of being modified without difficulty so as to produce equally with the old weaving and warp looms solid tissues or webs. But its high relative cost in construction has hitherto prevented its use for this purpose.

Thus John Heathcoat devised and accomplished the construction of the traversing bobbin net machine, "by far the most expensive and complex apparatus existing in the whole range of textile mechanism," and which remains in principle embodied in those of the present day, though with great improvements, some effected by himself, and many more by others to whom he was ever anxious to accord their due meed of praise, mentioning "John Brown, W. Morley, Braley, Levers, Sewell, and others, as especially worthy of notice, for their employment of genius and talents only second in their results to those by which the original machine was designed and executed." These modifications of the original machine arranged themselves under five systems, all of which were of English origin.

His success was not without its commensurate cost. It was gained by the employment of self-directed talents during years of great bodily and mental toil, carried on without aid from the skill and experience of others. He was encouraged to prosecute the task only by determination to succeed in overcoming difficulties in the progress of the work, which he found to be so great as to lead him to say, when describing them long afterwards, that "if they were to be done again, he should probably not attempt to overcome them." This is an instance of the successful application of mental and physical powers well directed and controlled, which may be advantageously pondered over by young men in every rank of life. At twenty-four years of age here stands the conscious yet modest inventor of one of the most intricate machines the world has ever seen.

Strict domestic economy and personal self-denial were necessary, and were cheerfully exemplified during this long outlay of time and money—an interval which must have called into exercise much faith and patience on the part of Mrs. Heathcoat. This seems to have

reached its culminating point when, as related by herself with gratitude in after years of prosperity, on one eventful Saturday her husband returned home, she enquired as often before, "Well, will it work?" His reply was "No! I have had to take it all in pieces again." Though kindly spoken in encouraging tones, yet it was with an almost painful calmness; and she was constrained for once to sit down and cry bitterly. Happily, she had confidence in his ultimate accomplishment of the task he had set himself. Her loving and brave heart had only to wait a few weeks more, when the hoped for result came, and she had the first narrow breadth of machine wrought traversed net placed in her hands by him, of whose talents and success, and the honourable influence to which they led, she was justly proud. That piece of net after being worn some years, was verified on oath, and an impression from it is given in Plate XIV., No. 14, in specimens of lace.

The excellence of the articles which this machine was capable of producing, was equal to its wonderful construction. See Plate XIV., No. 15. "The net," says M. Aubry, "is the king of tissues, and is a perfect imitation of the pillow mesh. It therefore soon became exceedingly popular, and has still further developed the manufactures of Nottingham, so that it has now become the centre of one of the largest manufactories in England. Ure says, *Dictionary of Arts*, p. 730, "bobbin net surpasses every other branch of industry, by the complex ingenuity of its machinery. A bobbin net frame is as much beyond the most curious chronometer, as that is beyond a roasting jack."

The guage or fineness of a bobbin net machine, like that of a stocking-frame, which is reckoned by the number of needles there are in an inch in its width, is computed by the number of bobbins and carriages that pass too and fro in each inch of the combs along the width of the machine, and the consequent number of points to take up the meshes as they are formed up to the work roller. If there are ten carriages and combs and points in an inch, then it is called ten-point. There are as coarse as four-point, and as fine as sixteen-point. The net may be made stiffer or slacker on the same

machine, and there may be therefore from ten to thirty holes lengthwise in an inch. The first machine made by Heathcoat on the principle of his second patent and called the 'old Loughborough', was a nine-point, eighteen inches (two quarters) wide. Then he constructed two ten-points the same width; then one thirty inches, followed by one thirty-six inches (four quarters), all ten-points. After the first large factory was occupied about 1810, a six quarter was built; and the labour in working this three-fold width of machine was then considered so great, that one Simpkin, a tall powerful man, was selected and put into it. He could earn £5 in three days, which was generally considered a week's work in this new and highly paid employment. Bobbin net was for some years made entirely from bleached cotton yarns, and 6*s.* 6*d.* a rack was paid for producing four quarter nine-point net. Many hands were thus earning during the first years of the patent from £5 to £10 weekly. The numbers of unemployed in the existing lace trade were thereby gradually lessened. Yet, by many, these new machines were looked upon as shortening labour, and were disliked and decried accordingly.

While Mr. Heathcoat was engaged in perfecting and preparing to patent his inventions, he became known for his talents and pleasing manners to several respectable families around him. Amongst others, to that of Mr. Brewin, whose friendship he much valued through life, and whose son, the late Mr. Ambrose Brewin, after an engagement for some years as manager, entered into partnership with Mr. Heathcoat in the Tiverton works. He became the husband of his younger daughter, and after a useful life, died much regretted some years before his father-in-law. About the year 1806, Mr. Heathcoat was favoured with the friendly regard of Dr. Peach, a medical gentleman then resident at Loughborough. To him he was indebted for scientific information and encouragement which was then of great value to him. He also introduced him to Mr. R. Blunt, who assisted in drawing the patent specifications, and to Mr. Charles Staveley a civil engineer, who made the drawings for them from the machines; and which, considering their intricacy

and the rarity of such employment at that time and in that district, reflect great credit on his skill as a draughtsman. He afterwards offered to construct the second machine from the specifications and drawings when their accuracy was impugned.

The pecuniary outlay which was incurred during the years 1807 and 1808 was beyond Mr. Heathcoat's means to sustain comfortably. Now that the second patent had to be secured, it was time for him to obtain other aid. A friend, Mr. Seddon, of Leicester, had rendered some assistance, which could not however be continued. Messrs. Boden, Oliver and Cartwright, hosiers of Loughborough, then entered into arrangements, under which he prosecuted his labours; but after a time they renounced their connection with the business, as too hazardous an investment. About this time, Mr. Thomas Hallam, who had been brought up in the lace trade at Nottingham, when the point net was becoming unprofitable as a manufacture, removed to Loughborough, and entered into the employment of Mr. Heathcoat. This occurred almost immediately after the invention of the first patented machine. He found Johnson, Bailey, Harriman, and Cross already in his service. Upon Oliver and Boden's withdrawal, and at the suggestion of Hallam, who was confidentially consulted having a knowledge of the houses engaged in that trade, Mr. Heathcoat not finding Mr. Nunn an extensive lace manufacturer at home, called upon Mr. Charles Lacy, and shewed him a sample of his new production. Lacy was in the point net trade, and closely connected with Mr. James Fisher, the eminent lace merchant in London, to whom this sample was forthwith sent. Fisher suggested the article being made on machinery suitable for producing it in greater widths, which Heathcoat intimated his determination if possible to effect. A few days after an arrangement was entered into, by which Lacy was to furnish capital, and become an equal partner with Heathcoat in the profits of the business. Heathcoat was to have the entire management of the machinery, while Lacy should fit the production for the market and dispose of it in Nottingham. Under this partnership the machinery

was so increased, as that, by 1816, fifty-five frames were at work in their factory at Loughborough. Thus Mr. Lacy became joint proprietor in the bobbin net patent. His well-known peculiar characteristics increased the dislike felt in Nottingham to the payment of tribute under the patent, which though not exorbitant, was very profitable to the patentees. Mr. Lacy unhappily embarked his share in mechanical experiments which exhausted all his gains. When that reverse occurred, the author was requested to apply to Mr. Heathcoat to head a subscription for his support. He replied, "Say to the gentlemen from me, that our partnership put between £40,000 and £50,000 clear gain into Mr. Lacy's pocket. If they should think, that after my skill and labour had done that for him without any expense on his part, I can be reasonably called upon to help him now that he has foolishly thrown it away, I will do so. I will act as they judge is right." The fact stated was considered amply sufficient, and the application was respectfully withdrawn. Mr. Fisher from that time allowed an annuity, it was said, of £200 a-year, to Mr. Lacy and his daughter for the rest of their lives.

The title to the invention of a machine whose incipient capacity was so greatly in advance of previously known means of production of lace, and which was soon found capable of improvement so as to vastly extend its powers and results, was not likely to pass unquestioned, especially as the articles made upon it were sold at prices affording unusual profits. Accordingly a number of claimants to partake of the honour of the invention arose on the one hand, and Heathcoat's specification being at once obtained, infringers quietly set to work with ability and success on the other. Much was said and written during the existence of the patent impugning the claim of Heathcoat to originality of the invention, and he was denied by some any merit beyond peculiarity of construction in his machine. We have already seen that before 1800, twisted and traversed net had not been made by machinery, that by Robert Brown's patent it could not be made, and that Whittaker and Hood's efforts were ineffectual in producing this result. The whole body of historical evidence coincides

with that forthcoming when the question as to the originality of the invention was put in course for legal decision. The opinion then given by Sir I. Brunel, adopted by the judge Sir V. Gibbs, and ratified by the verdict of the jury, is without doubt the correct one:

"That when Heathcoat had separated one half the threads placing them on the beam as warp threads, and made the bobbins which carried the other threads to act between and around these warp threads, so as to produce Buckinghamshire pillow lace, the lace machine was invented."

Notwithstanding the patentee's dislike to waste money, and time almost valuable to him then as money, in law—an injunction was applied for in 1813, against Mr. William Morley, a machine builder and then in partnership with Messrs. Kendall and Allen, by Heathcoat for infringements of his patent, he stating himself to be the inventor of the bobbin net machine. Morley replied in substance:

"That the machine was not Heathcoat's invention, such machines worked by several persons having produced similar bobbin net long before; that he had leave from Heathcoat to work them; and that their machines were materially different to his.—Heathcoat denied permission to use, and asserted that the variations were colourable and immaterial; charged them with selling the goods made by other infringers, and required their names and an account. He says they refused inspection, but he had seen a top and bottom roller of a lace frame delivered at Kendall's house. Defendants answered that some of the material parts of Heathcoat's machines were taken from older inventions. They admitted that bobbin net can be made wider from all lace machines, including Heathcoat's, than by hand, but asserted that the latter was not an original machine. They alleged that he cannot supply the market with sufficient net; that they had only worked two machines and those for but two months, the lace from which was sold by John Allen, but had ceased to make or sell any since this application, yet insisted on their right to do both."

They further say:

"That Edward Whittaker, Robert Brown, and others, were the inventors of the most important parts of this machine, and that their machines were different to the patent ones of Heathcoat's in principle, method, parts, and movements; and were not either counterfeits or imitations of his."

They nevertheless put in a schedule of bobbin net made by them, viz. 324 yards, of which 252 yards were sold for £290. 10*s*. and 72 yards were on hand. After the hearing, the injunction sought for was granted, and

the defendants became licensees under the patent. The following statements, extracted from a large mass of a similar tenor which was brought forwards in 1813, will throw further light on the points raised in this inquiry, and are otherwise of interest:

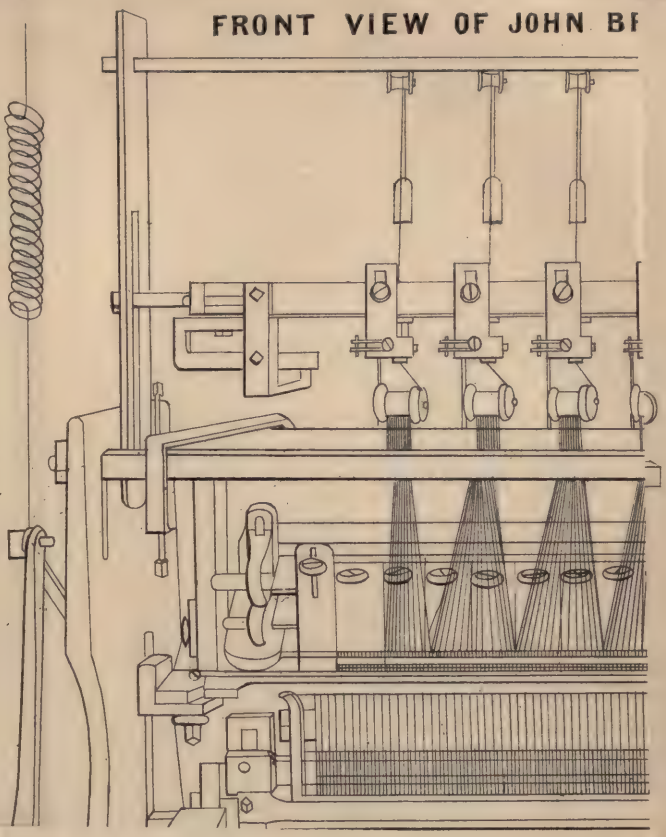
"William Flint, then aged 63, had lived nearly all his life in Nottingham where he had been a lace manufacturer eighteen years; knew the texture and mode of making Buckingham lace, and was acquainted with every kind of lace machinery used since he could remember. He invented the point net frame and sold the invention, which was afterwards patented. He never heard of any invention before Heathcoat's by which bobbin net could be made; had there been such he must have heard of it. He had tried to invent it, but did not succeed. Many others did so and without success."

"Edward Morley, for thirty years a frame smith and setter up in Nottingham, had been ten years with Frost, an eminent mechanician in hosiery and lace frames of every kind. They both knew all the meshes already produced by machinery, having been employed in devising and constructing them. Many had tried to construct a twist and traverse lace machine, but none had succeeded before Heathcoat. He must have known it if there had been. The patented invention was soon heard of, and only credited when the lace produced by it was seen—on account of previous failures. The specification was brought and many went on to construct them."

This Mr. Edward Morley became from his universal knowledge of the construction and value of hosiery and lace frames, the auctioneer or salesman through whose hands nearly all Nottinghamshire machinery that was sold for many years passed in order to be disposed of. It was from his books chiefly, that the author compiled his published account of such sales made during the preceding fourteen years to 1833—As to Robert Brown's machine Mr. John Farey, C.E., declared:

"That it could not by any modification be made to produce traversed and twisted net; nor could Heathcoat's produce fishing net; neither machine could be made to perform the functions of the other."

John Brown had, by a patent he had taken out in 1811 for a bobbin net machine, which was called from its contradistinguishing arrangement the traverse *warp*, Heathcoat's being a traversing *bobbin* machine, led the way to infringements. The construction and working of that class of machinery under Brown's patent gave apparently legal sanction to such parties; therefore Heathcoat in 1813 applied for an injunction also against him and his partners for infringement, by making and


FRONT VIEW OF JOHN BF

working bobbin net frames at Warwick. In opposing this, Messrs. Nunn, Brown and Freeman, say:

"They had invented and worked their machine before Heathcoat's patent. The machines do not interfere but differ materially. Their's is also patented. They admit Heathcoat's lace resembles foreign, and made at less expence and greater advantage than by any former method, and that he may have been the true inventor of his machine. That he could not supply the market sufficiently, and that their sales equalled his. That Brown, who had been in the lace trade ten years, found out his principle in 1807, and says that he communicated it to Freeman who lived with him, the same month, upon which they proceeded to make experiments, and at length a model and lace net; the latter in June, 1808. They became partners, and, wanting capital, Nunn joined them, and they got their patent in March, 1810; having only heard of Heathcoat's at the previous Christmas. By examining carefully his specification they found the plans to differ materially, and the Solicitor General decided on granting the patent. Until then they say they had known nothing of Heathcoat's method or principle, nor seen Heathcoat, his caveat, specifications, or plans. Brown was the inventor of the machine patented by him, which they assert is not a counterfeit or imitation of Heathcoat's, almost every movement and the whole apparatus differing from his. Finally, that he has all along known of their making lace, of which he had assisted with them to adjust prices, upon which subject they put in a letter from him. And they conclude by stating that Bailey said Mr. Heathcoat and he had examined the specifications of Brown, and found them to be on different principles and no infringement of Heathcoat's patent."

The last statement Mr. Heathcoat point blank denied.

An inspection of machines was refused, as also the injunction, the Chancellor not having a caveat from Heathcoat before him, and he ordered a trial on a writ issued from the King's Bench. Models were prepared, that of the 'Old Loughborough' patent machine was made by Mr. John Gimson, and the damages were laid at £50,000. But a surprising and untoward discovery occurred, which caused the record to be withdrawn, and not only put a stop to this action, but to every other legal proceeding by Mr. Heathcoat to protect himself from infringements, until the validity of his patent had been indirectly established, by the dictum of the judge and verdict of the jury in the action Bovill *v.* Moore, tried in 1816.

The circumstances were these. Mr. Millington was working a model of Heathcoat's frame, movement by movement as the specification was read, when it was made apparent that there was a difference between the

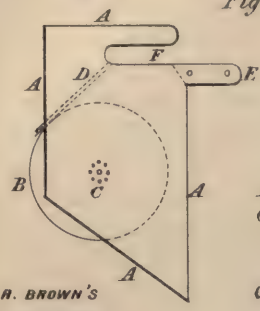
draft and engrossed specification, arising from the omission in the latter of a whole line describing five movements of the carriages which, being a repetition of the line preceding, had evidently been considered by the copyist as a mistaken repetition, and had been dashed through and left out in the engrossment. To make it sense, the word *bring* had been inserted instead of *put*. In confirmation of the practical sufficiency of the specification, notwithstanding these errors and shewing the mistake of those who said the machine was too intricate to be worked (which indeed the number and success of a multitude of infringers effectually disproved), a common workman having had the texture of the lace explained to him, made a model from the specification and drawings, on which he placed threads and made net. Being illiterate, he did not take the trouble to read the latter part of the directions, but worked on unconsciously supplying the gap.

This deficiency, though not necessarily fatal in equity or even probably so, Serjeant Copley (Lord Lyndhurst), thought might be taken as a valid objection at common law, and advised that further proceedings against infringers should be postponed.

On this occasion Mr. Sylvester, C.E., described the essential parts of both Heathcoat and J. Brown's patents to be identical. Mr. Nicholson, C.E., declared them to be so alike that if the essential part of Heathcoat's were withdrawn, the traverse warp could not be worked at all. And in this, Mr. Farey, C.E., entirely coincided. In his affidavit, John Millward, of Olney, Bucks, (aged sixty-five, and forty years in the pillow lace trade) said, "he never heard of machine bobbin net till that of Heathcoat's, nor saw a machine till a day or two before, when Whittington, Brunell and Donkin, each worked on the model. They came to a stop though working to the patent (specification). He saw they were wrong and what they had to do, and told them how the threads were further to be disposed of so as to make the lace." This 'stop' was the result of the deficiency above described.

Mr. John Bailey gave, in 1813, the following description and remarks upon the essential parts of Heathcoat's,

Fig. 1

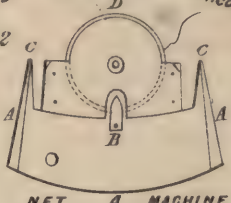


R. BROWN'S

A. Sinker
B. Bobbin
C. Pivot
D. Spring
E. Slide
F. Notch

BOBBIN & CARRIAGE OF HEATHCOATS.

Fig. 2

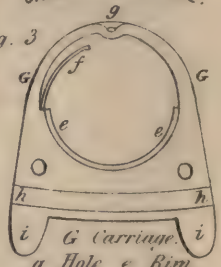


NET A MACHINE.

A. Carriage B. Spring
C. Catches D. Bobbin

BOBBIN CARRIAGE CIRCULAR MACHINE.

Fig. 3



G Carriage.
g. Hole e. Rim
for Thread f. Spring
h. Groove.

CARRIAGE OF LEVER'S MACHINE.

Fig. 5

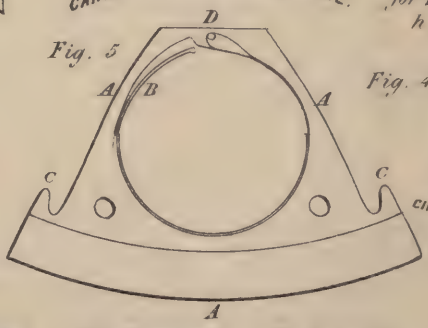
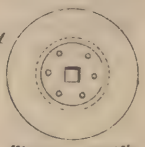


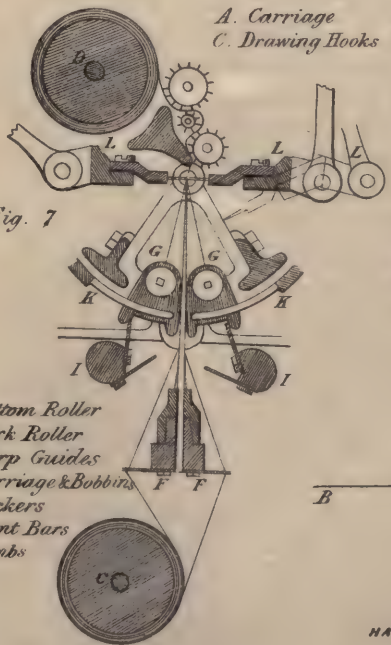
Fig. 4



WEFT BOBBIN CIRCULAR MACHINE.

A. Carriage B. Spring
C. Drawing Hooks D. Hole for Thread.

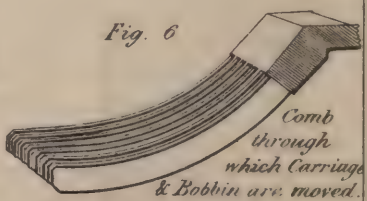
Fig. 7



C. Bottom Roller
D. Work Roller
F. Warp Guides
G. Carriage & Bobbins
I. Lockers
L. Point Bars
K. Combs

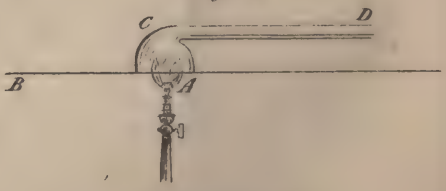
SECTION OF CIRCULAR MACHINE.

Fig. 6



Comb through which Carriage & Bobbin are moved.

Fig. 8.



HALL'S GASSING APPARATUS.

W. Metcalfe Lithog.

as compared with those of the machine patented by Messrs. Nunn, Brown and Freeman. It is very terse and lucid, giving a high idea of the talent of this artizan:

"In it an arrangement is made to place and work together forty to sixty threads in the space of one inch, by putting half the threads on a beam roller, and half individually on bobbins; and so as to pass through the beam threads first on one side and then repass on the other, and so twisting round each other. The roller threads run longitudinally, the bobbin threads diagonally. *John Brown's patent merely reverses this arrangement—the longitudinal threads are on bobbins, the diagonal are from the roller.*

"The bobbins are put into two rows to give twice the thickness to each bobbin, one row moves *behind* the other; *in Brown's, one row is placed and moves over the other.*

"The operation of twisting takes place upon one half the threads instead of the whole, and requires that the roller beam be placed farther from where the threads unite to form the lace, than the bobbins containing the other half of the threads; which last named bobbins require to be passed and repassed between the beam threads, which are held at equal distances for that purpose. *Brown's arrangements are in all these points the same.*

"The bobbins need to be guided through the threads by combs corresponding with the distances between the threads. These combs are placed in bars which are capable of a shogging (side) motion, removing the whole row of bobbins from opposite one set of spaces to opposite the next spaces, one remove to the right or left as the case may be. *Brown has comb bars and performs the same movements as Heathcoat's.*

"In order to these movements, it is necessary that the bobbins should be peculiarly constructed; so thin as that the requisite number when put into their carriages should be worked in a given space; should pass and repass the beam threads by being operated on by a shifting bar passing them half way through the threads, and another receiving them on the other side not catching the beam threads, and giving off thread with a proper tension. *Brown's are exactly similar.*

"To prevent more thread being given off the bobbins in passing backwards and forwards through the threads, than is taken up by the twist, the combs are arranged on the circumference of a circle, and the shifting or locking bars move on an axis on the like circle, of which the centre is where the work is made. *Brown has copied these parts and to attain the same object.*

"The twisting operation forms the sides; to finish the mesh, the diagonally working threads in Heathcoat's are made to cross; *in Brown's the longitudinal threads cross.*

"To secure the crossing, carry home the twist, and draw a quantity of thread from the respective sources equal to the quantity used in forming the last row of meshes, a row of points enters the threads, and the cross is carried out of the way of twisting; an upper row of points then carries the cross up to the work, close enough to make the meshes of the proper size; and the last row of points bears up the

meshes to a certain point as they are made, and at the same time draw from their various sources a sufficient amount of thread for the next course or row, and a work beam receives the net as fast as it is formed. *In all these particulars Brown's arrangements are the same, only reversed, working downwards instead of upwards.*"

The Mr. John Wallis, jun., before spoken of in connection with Whittaker's and Hood's frames, having a perfect knowledge of the bobbin net machinery and manufacture from its commencement, and being the acting partner and manager in the firm of Paget and Wallis, extensive makers of bobbin net lace for many years, the author requested his unbiassed opinion in the conversation of 1846, as to whom the merit of the invention patented by Heathcoat in 1809, really belonged. He had no doubt on that point himself; but desired to give the readers of such a work as that on which he is now engaged all the satisfaction possible. In reply Mr. Wallis stated it to be his opinion:

"That the bobbin net machine was the invention of Mr. Heathcoat; and that its diversified and intricate movements and combinations are exceedingly ingenious, and claim for him all the credit that can be given. Whatever parts others might have contrived, or schemes they might have formed, he put the machinery together, and so combined it as to produce *traversed* bobbin net, which without doubt nobody else had done."

Mr. Wallis went on to refer specially—

"To the division of threads into warp and bobbin, to the separation of the bobbin threads into two parts, and the mode of causing these sets to travel opposite ways, the introduction of the shogging (side) movement, and the exact application of the four-point bars, together with the working of the bobbins and carriages in combs adjusted in parts of the segment of a circle of which the finished web is the centre," &c.

He concluded his remarks thus:

"Possibly by his claiming the *bobbin*, his patent might have been overthrown; yet, nevertheless, he would still have been the *true* inventor of this machine. Nobody had constructed a bobbin *traverse* net machine before him; and it is not certain any one else might. For as to Brown and Freeman's 'traverse warp' machine, I do not think for a moment it was other than an inverted copy of Heathcoat's."

After a thorough examination of every other net making machine then known, and of the bobbin net machine patented by Heathcoat, and called the 'Old Loughborough,' Sir J. Brunell publicly stated in 1815:

"That the latter appeared to him one of the most complete mechanical combinations, and in which its author displayed uncommon powers of invention. Therefore he could not withhold the tribute due to him for originality and ingenuity in all the various parts he had brought into action, to accomplish a texture which had been attempted before, but, to his knowledge, without success."

A diligent examination of a surprisingly voluminous mass of papers, briefs, and evidence given on oath and otherwise, on all sides of the litigation to which Heathcoat's and John Brown's patents gave rise, has been made by the author. Lindley and Whittaker must have awarded to them their due for their bobbin; Robert Brown for his sinker and bobbin, and Charles Hood for his ability in employing these instruments, so far as he did use them, in approaching success more nearly than any of his predecessors. It may be presumed also that Mr. Heathcoat might and almost of necessity must have had his mind directed in some degree by the attempts of others. Before he had completed his own machinery, he had not however seen either Brown, Whittaker, or Hood's machinery. Most of the instruments he used were known before, but used for other combinations or for other purposes. Some had been employed in unsuccessful efforts to do that in which he succeeded. In the hands of his competitors they had proved practically useless as to the solution of the intricate problem. Whatever these might be, Mr. Heathcoat relegated the necessary parts into their appropriate position, giving them form and motion by his mechanical skill, with those additions which he found necessary to the attainment of the end he had in view. Thus we also are brought to the conclusion that he was not only the first to construct, of which no one has now any doubts, but claims of right the singular merit of having invented the twisting and traversing bobbin net machine.

It may be mentioned here, that in 1813, Mr. Heathcoat, still of Loughborough, took out an additional patent, No. 3673, for improvements in his machine for making bobbin net, or lace nearly resembling foreign lace:

These consisted of substitution of iron for wood where the latter material had been used. Also improved guides and 'turn again' were

introduced so that these brasses were not moved by hand. Straps were put instead of pulleys to give movements. The selvages were held out by roller pins or points, called spur wheels, instead of a stretcher pointed at each end; with other simplifications of the interior working parts of the machine. Also he now added to his machines the apparatus whereby the narrow breadths called quillings were made. The traversing bobbin threads were caused to turn again at intervals in the work equal to the desired width of the strip of net. A lacing thread put in while the work was going on kept the adjoining breadths united; these were afterwards drawn out when the piece was dressed, leaving a sound selvage on each side of the breadths, but not so perfect as the quillings made on the traverse warp machine.

The price paid for making five-quarters net was 3*s.* 6*d.* a rack, in 1834 it was 1*d.* A twenty-four rack piece sold in 1814 for £17, it was worth 7*s.* in 1834.

In 1813 Jeremiah Bryant, of Nottingham, improved the catch bars in the 'Old Loughborough' machine by using notched wheels instead of working them by hand, and devised a better mode of 'hogging' the twist. By these means the speed was increased.

The same year the movements of this frame were still further lessened by the combined ingenuity of William Braley, William Henson and Thomas Brookes. The machine as modified by them was long used. Henson removed soon after to Worcester.

Greenwood, a workman, so arranged the 'Old Loughborough' double tier of Heathcoat in 1815 as to reduce the motions necessary to produce the net from thirteen to six, and by so much increased the speed. This was effected by a peculiar kind of vibratory movements, but their mode of operation was so complex and delicate that only about ten of these frames were ever constructed.

These were the most successful of the many ingenious modifications of the machine patented by Heathcoat, made at that time, when every step that issued in reducing its complexity and increasing its speed, whether worked under license or through infringement, was attended by profits of an unusual amount.

CHAPTER XV.

THE TRAVERSE WARP MACHINES.

The importance of the litigation initiated by Nunn, Brown, and Freeman, through obtaining an injunction against Moore, Longmire, and Noble, and issuing on the order of Lord Eldon, in a trial of the validity of John Brown's traverse warp patent in 1816, was very great, whether in reference to the interests of the litigants, or those of Heathcoat, and the arrangements, position, and progress of the trade at large, when influenced by the establishment of the paramount rights of the original patentee. The excitement felt upon the occasion was naturally very great; and commensurate efforts were put forth on all sides. The amount of evidence given, and much more that was prepared, added to facts from other sources, enable us to trace out the history of the traverse warp invention.

Mr. Nunn, one of the plaintiffs, was a lace manufacturer and a man of property at Nottingham. Finding that the value of Heathcoat's invention was great, he offered a reward to any artificer who could construct a machine to make bobbin net lace. He spent a good deal of money in employing Whittaker, Elliott, Rowland, Hill, and others, in trying to do so. Nunn had a copy of Heathcoat's specification, and put it into the hands of the persons he so employed. He at length met with John Brown, who had been attempting the task with Freeman. The aid of James Sneath, a frame-smith, was called in, when Brown and Freeman met with obstacles they knew not how to overcome, and, as Sneath always averred, by his assistance it was completed in 1810-11.

The steps by which this was accomplished, as stated by credible and competent persons, were as follows:

Whittaker was shewn Heathcoat's specifications by one Cockin, a workman, in 1810, and was taken by him to Nunn. With Bailey he went to see one Hill's machinery, for the purpose of trying to get from Bailey particulars relating to Mr. Heathcoat's machinery. At Nunn's request, Whittaker entered into his service for 30*s.*, or thereabouts, weekly, in order to make a twist-frame, and worked in the parlour of one Young; Rowland working in the top shop, Glazeby in the middle shop, Elliott at home, Hill at Nunn's house, and all were employed by Nunn; Glazeby's brother, a working smith, in Heathcoat's service, often coming to help them. Edward Morley shewed one Young how the bobbin net mesh is made by using a fox and goose board. Whittaker averred that Brown and Freeman had taken Heathcoat's plan for their ground work, but altered it to avoid his patent. They came, he said, to his house every night, for many weeks, in order to know what he had learnt of Heathcoat's machinery.

John Holmes lived at Birch Row, near Radford, about 1810, and Robert Harvey with him. Brown and Freeman soon came to live at the next door. Before September, 1810, Holmes often talked with Brown, who said he was trying to make a bobbin net machine, he and Freeman having each sold a point-net frame, and Brown his furniture for money, with which to make experiments, but they could not succeed. In September, he said he had begun to try again. Afterwards he stated he had got bobbin net on the machine, and shewed him some about two inches wide and five inches long, and about five meshes to an inch in quality. It was made of different coloured threads, by which their direction was indicated. Brown had often spoken of the plan of Heathcoat's machine, now saying he believed he was near it, as he had before tried with twenty-two threads to the inch in width, but had got rid of half the bobbins and made net of the same fineness as before. He then asked Harvey to join him, but he declined, fearing their want of success and the loss of his money. Brown said, Loughborough lace was good but too thick and heavy, and he had improved upon it, making the ground thinner and with

better selvages. Holmes saw his bobbins. Brown having joined Nunn in November, 1810, their acquaintance declined; and as each left their dwellings at New Radford in March, 1811, it ceased altogether. Between June and November, 1810, Brown was often absent, but Holmes did not know where.

Abraham Trivett had been, in 1813, seventeen years a lace manufacturer at Nottingham, seven years of which he was in warp goods and machinery, and is described as a "clever neat man." In 1810 he worked lace for Mr. Hayne, and talked with Lindley, his manager, about Heathcoat's patent net. Trivett and another tried to make it, but Hayne and Lindley said it would be an infringement, and had better not be meddled with. Trivett had known James Sneath for six years in 1810, as he had made several warp machines for him. About Christmas that year, he heard Sneath was trying at something with Brown and Freeman, and was told afterwards it was the traverse warp which they before long patented.

Mr. Stephen Moore states, that he remembers John Brown living near his father's house at New Radford in 1810, and shewing his father out of a window a wooden model of machinery of some kind, as something of importance. This Mr. Moore, sen., was the inventor of the traverse warp frame of the defendants. John Bailey had conversations with Nunn, Brown, and Freeman, by Heathcoat's knowledge and permission, about their machinery. Brown told Bailey that the bobbin in their machine had only one spring, and only three motions for twisting; also expressed wonder how Heathcoat could make such fine net from such coarse guages. This was in October, 1810, when Nunn also went over to Loughborough, and through Chapman, a draper, got an interview with Bailey, who was taken by him to Nottingham in a chaise, arriving there at midnight. On the way, Nunn showed Bailey a bobbin, which he at once recognized, and told him it was made at Mr. Heathcoat's factory. This Nunn denied. He pressed Bailey to enter his employ and make a machine; this Bailey declined, while in the service of Heathcoat and Lacy. Nunn alleged that

Lacy had defrauded him lately of £500 or £600, and trembled for any fortune connected with Lacy. Bailey pointed out to Nunn that the machinery shewn to him by Nunn, being intended to use only warp, could not produce traversed or sound net. This the drawings and specifications of Heathcoat, then in Nunn's hand, shewed his did. Upon which Nunn said that he feared the men were deceiving him. After an interview by Nunn with Brown and Freeman in another room, he told Bailey he had engaged with them to construct for him thirty machines to make bobbin net, ten of which were to be ready by Christmas. Nunn left for Bailey £2 in Chapman's hands to pay the expense of the journey.

James Hooley, hosier for forty-three years (1813) in Nottingham, had dealt in Morris's patent lace and every other braid made in Nottingham, and had frequent calls by inventors with improvements. He had never heard of machine bobbin net till he saw Heathcoat's, and was at once struck with its excellence. About two years after Heathcoat's patent, Nunn called on him and showed some new lace; he at once saw that it was an infringement and told him so. Nunn replied, he could make it from a different machine to Heathcoat's.

Blackner, writing in 1816, just after the question was settled, says—

"The merit of the invention by John Brown was in applying circulating planetary instruments and movements, enabling the warp threads to traverse diagonally in breadths with perfect selvages. Had he confined his claim to this, he would have gained the profit as well as credit of his ingenuity. The great obstacle of traversing from side to side had been overcome by Heathcoat already, to whom was principally owing the manufacture of bobbin net by machinery."

It is now time to describe the traverse warp machine, and the suits which followed thereon:

The patent, No. 3434, taken out April, 1811, in the name of John Brown, of New Radford, near Nottingham, lace net manufacturer, is entitled "A machine or machines for the manufacture of bobbin lace or twist net, similar to and resembling the Buckinghamshire lace net and French lace net, as made by the hand with bobbins on pillows."

From the peculiarity in its construction, by which

it was contradistinguished from that of Heathcoat, taken out and specified about twenty months before, it became known as the "*traverse warp*" machine. A description of the points of similarity to, and divergence from, Heathcoat's patented invention given in a former page, will suffice to enable the competent machinist to enter with ease into the following analysis of John Brown's specification, and the special questions raised by the long and expensive course of litigation to which these patents gave rise. The rights of invention claimed by each will necessarily, after such a number of clever heads had been at work upon their investigation as we have enumerated, bring forward and decide the question of an origin common to them both. It will be enough to say here, that while Heathcoat by his clear apprehension of the thing to be accomplished and judicious choice of the instruments whereby it was effected, shewed the highest inventive skill, his opponent in the points and mode of divergence from his forerunner, exhibited an amount of constructive genius, upon which Mr. Heathcoat long afterwards bestowed the warmest praise. John Brown, by his specification, describes every part of his machine, renouncing nothing as having been used before. Whether Heathcoat were an original inventor or not, yet, up to the points of divergence, he had clear priority over John Brown. By the latter claiming all, he lost what he would otherwise have been justly entitled to—a patent for the method of construction, so far as it was new, in any part of his machines, *i.e.* for traversing the warp threads instead of the bobbin, and producing perfect selvaged narrow breadths of lace.

Brown's machine has two beams, one on which the threads are wound, and the other to receive the lace. One half the threads employed are first wound on one beam and inserted into the other, the threads being parallel. The other half are contained in bobbins which are placed in carriages, and work in the circumference of a circle between the beams, the loose ends of these threads being inserted into the beam in which the others are inserted, and which is ultimately to receive the lace. The carriages are kept at equal distances by being placed between combs or teeth answering to Heathcoat's comb bar, and held fast during their motion by a bar pressing upon the carriages, called a 'locking bar', answering to Heathcoat's shifting bar. The crossing is performed by means of pins pushing one half the

diagonal threads to the right, and the other half to the left, forming two crosses, one of which is returned and used for the work. The other cross is done away by one half the diagonal threads moving to the right hand, and the other half to the left, changing the character of two bobbins every time they turn round the selvage. The crosses and twist are carried home to the edge of the plate by a swinging set of pins, and two sets of these act alternately.

Brown's beam on which the threads are wound is above, that containing the lace below; the bobbins, therefore, work in an inverted position between them. Brown works his lace carrying his cross and twist downwards. Heathcoat works just in the contrary order. The longitudinal threads in Brown's machine are those coming from the bobbins, those from the beam being diagonal threads.

These beam threads require that one half of them should traverse to the right, and the other half to the left, for the purpose of doing away one of the two crosses which is formed previously to twisting. This is effected by placing the beam in a frame like that which contains the roller of a castor in common table feet. The beam has thus two motions, one on its axis to wind up and let off the threads, and another upon an axis perpendicular to the other axis, by which the beam revolves in a plane parallel to its horizontal axis, the ends of the axis describing a circle of which it is the diameter. This beam is recommended by Brown to be of length equal to half the breadth of the lace to be formed. A little below this beam is a circular plate of brass fastened to the same frame which holds the beam, and turns with it upon the perpendicular axis on which the frame and beam turn together. The diameter of this plate is equal to the length of the beam. A circle near to the extreme edge of the plate is divided into a number of equal parts equal to half the number of threads, and then another circle immediately within this is divided into the same number, but so that each of the latter may be exactly between two divisions of the former. Small holes are perforated at all the divisions. These holes have to receive the threads from the beam above. The threads are wound on the beam in two layers, those in one layer passing through the holes in one half of the circumference of the plate, and those of the other layer through the other half. After the threads have descended a certain degree below the plates diverging as they proceed, they become of the intended width of the lace; at this distance the threads are received by a set of fixed points or pins, called 'dividers'; they serve to keep the threads at equal distances, and to prevent their diverging below this line.

Where the threads first pass through the plate they form a complete circle, the extreme threads in the right and left of the circle have simply a lateral divergence; those in the back and front at the greatest distance from the latter, will converge till they meet under the centre of the plate, while all the rest will take a compounded direction, meeting ultimately in a straight line determined by the face of the bar which contains the dividers.

The first threads which come from half of the circle will occupy the space between every other divider, while those in the back part of the circular plate will occupy the other vacant spaces. If the front half of the threads from the left hand were numbered 1, 3, 5, 7, &c. spaces of dividers; the back numbered in the same way would occupy 2, 4, 6, 8, &c. spaces of dividers.

It will be obvious that if the threads were detached from the dividers, and if free to move, the revolving motion of the circular plate would have the effect of causing one half of the threads to move to the right hand and the other to the left. This complicated apparatus is employed to do away the extra cross, instead of performing it by the lateral motion of the comb-bars. (It is much easier performed when the diagonal threads are contained in the bobbins, as Heathcoat's are, though there might be many contrivances to effect it without essentially altering the machine. A mere variation like this, in effecting this object, could by no means constitute an original machine, as endeavoured to be shewn by Brown's engineers, who spoke much of the planetary motion herein employed).

The diagonal threads being in one line, except while crossing, it is necessary to divide the threads into two rows before they can be moved in contrary directions. To effect this separation he employs two sets of pins forked at the ends to send out the threads from the dividers. One set of forks are longer and push out the threads which have to move to the right; the others are shorter, which have to push out those threads that move to the left. When two sets are thus formed one set is moved one division to the right, and another to the left, reciprocally changing the places of the threads. In this state they are allowed to fall into the dividers. The change will be effected of 1, 3, 5, &c., to occupy 2, 4, 6, &c., of divisions and *vice versâ*. Each pair of threads will now be crossed above and below each divider. Points are then raised to take down the lower cross. The upper cross has to be removed by the motion of the circular plate; each thread in the back half of the circle moving to the left, and those in the front half to the right, till the cross be removed.

Thus it will be seen that Brown's process of crossing does not differ materially from Heathcoat's. It has the same effect of forming two crosses, and has an extra motion in previous separation of threads.

The carriages are kept at equal distances by being placed in similar grooved bars; but where Heathcoat moves his bobbins in carriages along the grooves, Brown's combs move along with the bobbins. The pins employed in forcing up the cross act precisely alike in both. Heathcoat's crosses and takes up by two sets of pins. Brown also uses two sets for each.

It would perhaps be unlikely for any two other machines to be so different in appearance, yet so similar in construction and operation. A similarity of operation was admitted by Brown, but he denied similarity of construction. To this the following reply was made: "The bobbins in both move on pivots, and are held in place by springs. The carriages in each move in grooves or combs in the circumference of a circle by bars. The points act by lateral motion, forcing half the diagonal threads to the right, the other half to the left for crossing the threads in Heathcoat's, as do Brown's forks. Heathcoat's and Brown's points each

have a double motion to bring cross and twist to the work beam."

We now arrive at the case of Bovill *v.* Moore, in which the claim that was made to sustain the right of Brown and Freeman to the exclusive use of the machine they had constructed, was tried before Chief Justice Gibbs, on March 1st, 1816.

The Solicitor General for the plaintiffs rested his claim on this argument briefly stated:—"It is not necessary that every constituent part of a machine should be new, nor that any one part taken by itself should be new. It is sufficient if the combination be new, and applied for a purpose to which they had never been applied before. Almost all machines are composed of old parts; the beam, lever, roller, &c. are all old and well known; but if the combination be new and useful also, that will be sufficient: for the machine is composed of its different parts.

"In addition to 'point net' and 'warp net,' another machine (Heathcoat's) had been invented before this, with the view of making this sort of lace (traversed twist net), but Brown's machine was not similar to that in the combination of its parts, its productions, or the mode in which they are obtained. My case is not that this is a mere improvement on Heathcoat's machine, for if a man takes out a patent, and I, using that as a substratum only, invent a part, I should take out a patent only for the improvement I make. But however I may have had another machine before me, and though lace may have been produced by it, yet if my machine by a different combination of parts form together one new whole, then I do right to take my patent for a machine; for *qua* machine, it is a new one. I say this is a new machine; a new combination of parts producing a machine essentially different from any that has been produced before, though the effect of the former and the object of the present are the same; *i.e.* to produce lace on the same principle as a woman who works by hand producing lace. If the defendants can prove that mine is an imitation of their's that will avail them; but it is a new combination of parts effectually constituting a new machine." The Solicitor General also pointedly remarked: "It is most extraordinary that Heathcoat's patent was taken out in 1809 and John Brown's in 1811, that if the former deemed the latter an infringement he had never thought fit to bring any action in a Court of Justice on account of it."

With the reason for this reticence on the part of Heathcoat, the reader is already acquainted. At the time it was not known much beyond his advisers, legal and otherwise; nor was it politic or necessary to explain it upon this occasion.

Serjeant Copley, for defendants, thus stated, in brief, their case: "A new combination of old machinery may be the subject of a patent; but when one takes out such a patent he should call it 'a new combination of old machinery,' or 'an improvement of former machinery.'

High authority has decided that, the Act requiring the specification, when he specifies to what his patent goes, he must describe what is old and what is new. If he takes to himself every part by the terms of his specification, then there is no individual who could take any part of it, and the public has a right to know what he claims and what he does not. Now Brown describes all the simple parts of his machine and all its combinations, and thus appropriates to himself more than he is entitled to; this patent therefore cannot be sustained. The primary parts into which his machine may be ultimately resolved will be shewn to be old; and that the complete combination of it is old. There are parts of this machine which, if taken away, it would not work; and which parts are in themselves machines, and are now subjects of patents. These the plaintiff has incorporated in his patent without describing them as old, and as such he appropriates them to himself. The only point of originality in his patent consists in his making the beam threads traverse instead of making the bobbin threads traverse. In other respects it is similar to those used in Nottingham for a considerable time past."

The learned Serjeant had thoroughly studied both the machines, and made net on Heathcoat's, so that he was enabled to work the models on the table, explaining the various parts and precise nature of the invention with such clearness, as to astonish alike judge and counsel, jury and spectators. His masterly handling of the case was much and most favourably remarked upon at the time, and had, it was said, an important bearing on his subsequent professional career.

Chief Justice Gibbs concluded his summing up of the evidence thus: "If a conformation of those parts existed before, or if a combination of a certain number of those parts existed up to a given point before, and Brown's invention springs from that point and adds other combinations to it, then his specification stating the whole machine as his invention is bad. But if you think he has the merit of inventing the combination of all the parts from the beginning, I think his specification is good, and that he is entitled to your verdict."

The jury immediately pronounced a verdict for the defendants.

The Chief Justice: "Do you find the combination of the parts up to the crossing of the threads is not new?" The Foreman: "Yes, my lord." A Juryman: "The threads then taking a new direction; and certainly the most valuable part to the plaintiff is a new invention; but it is nothing more than an improvement."

A new trial being moved for before Lord Chief Justice Gibbs, Dallas, and Parke, (Abbott not present), it was unanimously refused on the ground that "a patent must not be more extensive than the invention. If the invention consisted of an addition or improvement only, a patent for the whole machine was void."

This conclusion of the conflict between the infringers themselves gave as its necessary consequence a legalized firm ground to sustain the original patentee in claiming his rights. Amongst those who submitted to them, were the plaintiffs and defendants in the late action.

It is interesting to know in what way Heathcoat viewed John Brown's traverse warp machine, and its position in regard to his own patented invention. His words are these:

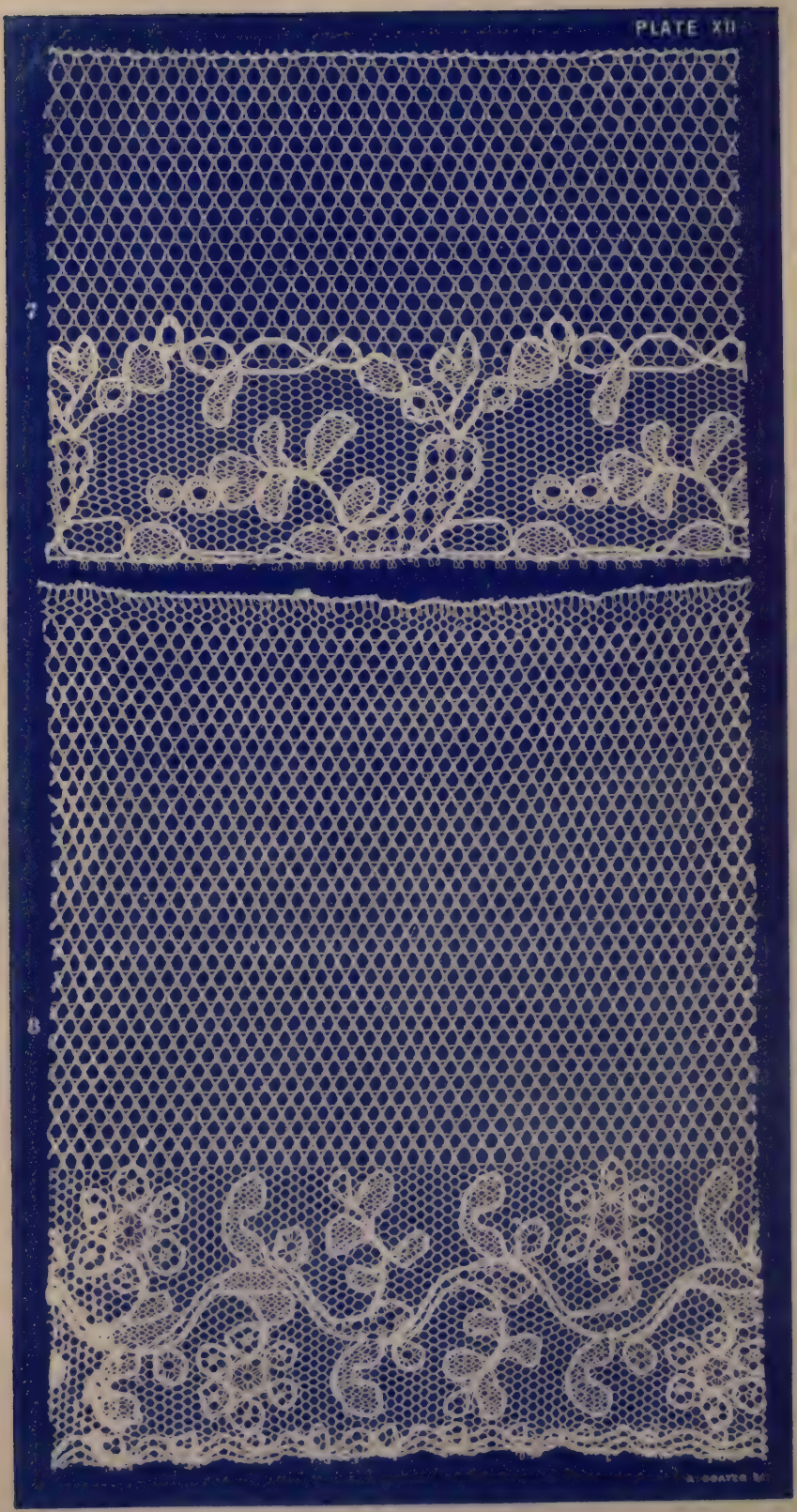
"John Brown arranged his traverse warp and took out a patent for it *as for an entirely new invention;* not, as it really was, in the then state of knowledge as to the principle of my machine, a *great improvement,* enabling *very narrow breadths* to be made, though slowly, *of excellent texture,* indeed perhaps *superior to any other.* Soon after this Benjamin Moore constructed his traverse warp, and being sued as an infringer by Brown, two trials took place. Moore's reply in substance was, that Brown's machine was not new; and that if there were any infringement, it was by both Brown and Moore of my patent."

This statement of the matter is the correct one. As a machine for making plain net breadths, the traverse warp was unrivalled. When quillings went out of fashion, notwithstanding a simple and effective application of Jacquard apparatus to these frames, they have succumbed to the levers and have almost disappeared. We hope one of them may make its way to the Kensington Museum before the remainder are broken up. It is certainly a most interesting machine as a study. Thus Mr. Babbage designated it to the author after a two hours' close examination in 1833. It was a marvellous instance of constructive genius. Within two years of Heathcoat's specification reaching Nottingham, this surprising travesty of it made its appearance; and within two years more, from an independent quarter, a second machine having all its special character and attaining a similar end was brought out. There must have been an astonishing aptitude for overcoming mechanical difficulties at that epoch in the district whence these feats of skill emanated. Setting aside all considerations of plagiarism and infringement, this tribute of admiration is due to the talent which dared to attempt and actually succeeded in causing the warp to traverse instead of the bobbin. A plate (No. VIII.) is given to assist in perpetuating the knowledge of this machine.

The defendant Benjamin Moore's machine was constructed, in conjunction with Longmire and Noble, in 1812, at New Radford, under circumstances of difficulty that would have dismayed most men. Thus much there is no doubt of, for though carried on almost upon the same spot where Brown's was commenced, it does not seem that there was any intercommunication between the parties, and it is not certain that Moore's was a copy of Brown's. On the contrary Moore's family declare it was an independent construction. There is not one of Moore's remaining to test the fact: but no doubt both had seen Heathcoat's plan and worked from a common source to a like end. Unquestionably the trade desired ardently to be freed from patent rights, and to share in the profits derived from the manufacture. The expense of the course of litigation between these parties, occurring from October, 1816, to July, 1817, was enormous; £4200 on the defendant Moore alone, *i.e.* the winning side; of which he received from the losing plaintiffs for taxed costs £1345 or £1488, it is not certain which. How much it cost Brown we could never ascertain. "During this period Mr. Heathcoat visited Mr. B. Moore, from time to time, to talk the affairs of traverse warp frames with him." The result of the trial was received with great joy at Nottingham.

This class of machines furnished so few incidents of importance to the trade in after years that they may be most conveniently related here. Mr. Samuel Weston reduced the traverse warp motions by crossing and lifting up the point bars at the same time. Mr. Samuel Moore first put the whipping thread apparatus to the breadths. Before then they had been whipped together by hand before dressing. Nunn and his partners tried at first to get their machines worked at Warwick by tape weavers, but they required far more highly skilled workmen, and to such they had to entrust them, paying them for some time £7 to £10 a-week wages. Part of their machines were afterwards taken to Blackfriar's Road, London, and part to Whippingham in the Isle of Wight. A portion of these have remained there till now. About 1819, Mr. Brown died in London a rich man. Mr. Freeman resided for years at Tewksbury, having realised

considerable wealth, it is said, amounting to what is called 'a plum.' In 1825, Crowder combined the pusher with the traverse warp, but the result was a too delicate machine. In 1828 spotted net was made on the traverse warp frame; also Barnes and Deverill put it on to rotary power, but the warp threads got entangled in work, and it failed. In 1831, Barnes and Z. Bryant failed in a combination of the levers and traverse warp. In their machine the warp traversed by the action of the worms of two screws revolving on horizontal pivots and carrying the front warp threads to the right and the back to the left. This year, T. Alcock, of Worcester, put into the traverse warp an extra point bar, rising and falling in every traverse to carry up twist and keep threads from entangling; upon this he is said to have made six racks in an hour. Alcock constructed the same year a single tier traverse warp with rolling locker; the carriages, four and a quarter inches long, moved in circular combs; it is said to have produced ten racks in an hour, but that is very doubtful. This year, 1832, Freeman produced spotted net without clipping threads, and also honey comb net. In 1833, Mr. Nunn made at his factory in the Isle of Wight, a pattern in imitation of French white silk blonde, which he called 'Neige.' This was sold as real lace without detection during a whole season, it is said to the amount of £60,000, of which sum probably £40,000 was profit. Mr. Birkin and Mr. Vickers were both threatened with legal proceedings by Nunn, for producing the same pattern and article on other kinds of machines. But the pattern had been copied originally from a foreign lace, and the threat was disregarded.



CHAPTER XVI.

LUDDISM.

The war of 1803 brought yearly increase of taxation, and, being attended by bad harvests, the whole nation suffered, but especially the midland district. The times became troublesome and dangerous, issuing in the revival of Luddism. Frame breaking, as a mode of intimidating employers into compliance with the views and wishes of their workpeople, did not originate in the midland counties and in the present century, as is generally supposed, but was practised in London at least 150 years ago, when the disputes which had occurred for some years respecting the number of apprentices taken by master stocking-makers, came to a point, because one Nicholson had gotten very many of them. The unemployed and irritated journeymen proceeded to break about 100 frames thus worked by him and others, throwing them out of the windows, beating both the obnoxious masters and their apprentices. This occurred about the year 1710, and was confined to Old Street Square, Bunhill Row and the neighbourhood in St. Luke's, Shoreditch, and Cripplegate. The masters were deterred by these proceedings, and agreed to abide by the trade rules as to apprentices in future; while none of the rioters were punished, it is said not even apprehended. But one of the masters who had thus promised, named Fellows, decided to remove his frames to Nottingham, where he set at nought the rules, and, it is said, had at one time forty-nine apprentices, of whom many were bound by their parishes to him; the practice being to pay at least £5 each to the masters on thus getting rid of them.

This system of apprenticing by parishes to the weaving trades throughout the country, besides causing

much suffering and demoralization to the oppressed and friendless youths of both sexes who were its victims, gradually so overloaded the trade with wandering unemployed journeymen, as to cause serious riots in various manufacturing populations.

A committee of the House of Commons, after sitting to hear evidence on the subject, instead of stopping the malpractices of parish officers, passed an act in 1727 punishing with *death* those who destroyed the machinery used in making cloth or hosiery of woollen materials. Whether from the terrible penalty thus threatened, or the greater area over which frame-work-knitting was rapidly spreading in England, acts of violence to the persons or property of hosiery employers seem to have practically ceased for forty years. Though the trade was manifestly leaving London, there were still colonies of stocking-makers here and there; one of the latest of which was located in Spitalfields, where the frames chiefly made silk hose; and thus were nearly allied as to materials with the staple weaving trade of that district. The latter was much excited in 1770 on account of depression of wages, and which were sought to be raised by the terror arising from nightly destruction of the warps in those looms, the wages for weaving in which were paid for at an under price. These nefarious proceedings were largely aided by the neighbouring frame-work-knitters. Some of the silk weaving rioters were taken, convicted, and hanged in front of the doors of the houses where the offences were committed. The London stocking-makers were greatly deterred by this severity from such lawless proceedings in future. Besides the Spitalfields' act, another was passed empowering justices to regulate wages, and if needs be to raise them—a measure which was not repealed until 1824.

The riotous spirit was not laid at rest; it had only migrated into the midland district of England. Two bills having been rejected in 1778-9, which had for their object the regulation of apprenticeships and prevention of fraudulent work, chiefly upon the evidence of Mr. Need and some other hosiers, the country stockingers flocked into Nottingham, their frames were thrown

broken into the streets, and a house was burnt down between 10th and 19th June, 1779. Much other property belonging to obnoxious hosiers was destroyed. The riot act was read, and soldiers were called out. Such was the effect upon the minds of the authorities as well as the hosiers, that at the instance of the former, the latter, on 19th June, declared themselves unanimously determined as a body, "provided an immediate cessation of violence took place, to remove every oppression from their workmen, and to bring all the manufacturers up to a fair price, not the highest rate, but the best generally given." Upon this peace was restored. A man, Mephringham, was tried at the assizes for aiding in burning the house, but was acquitted: upon which this sad conflict was allowed to come to an end. On this occasion about 300 stocking-frames belonging to Need and others were broken, they having been mostly employed in making spurious and, as it was then and up to 1850 generally considered by the workpeople, fraudulent work.

In 1773, a newly invented stocking-machine was taken out of the Exchange at Leicester by a mob and destroyed, in spite of the entreaties of the mayor and others. Also Coltman and Gardiner, wool combers of Leicester, had a man in their employ in 1788, who invented the present mode of spinning animal wool by machinery into worsted yarn, applying the principle embodied in Arkwright's cotton spinning frames. To this man, named Brookhouse, the Leicester woollen hosiery trade is indebted for laying the foundation for much of its great extent and flourishing condition. His new plan was approved and taken up by Messrs. Coltman and Whetstone, two of the largest makers of worsted yarn in Leicester, and machinery was constructed to carry it into effect. But it was all destroyed by a mob of workpeople, together with the dwellings of Coltman and Whetstone. Before the riot could be quelled the military were brought into the affray, and blood was shed.

Thus the use of this important process was driven from Leicester at that time into Worcestershire, Yorkshire, and even to Aberdeen; from which parts for the next

forty years, Leicester hosiers had to obtain much of the materials they worked up. Meantime Mr. Brookhouse set up his machinery at Warwick, and worked upon his invention with such success as to gain a fortune, upon which he retired.

A list of prices, which had been agreed to in 1787 by both masters and men, had been in the main adhered to during the following twenty years, when from rapidly decreasing demand lessened prices for goods and consequent pressure upon the workmen ensued. In 1809 several hosiers, amongst whom were Haynes, Nelson, Brocksopp, and Eaton, agreed to reduce their wages 3*s.* per dozen if the workmen would not or could not obtain a reduction of frame rents, and the entire cessation of cut up spurious work. To these two things the workmen were very heartily opposed; but at a time when they could only get scanty labour if any, such as was within their reach, however ill remunerated, was not to be rejected. The time and circumstances on which the author is now entering, he himself passed through, and he has a most painful and vivid recollection of them. The fear of an entire cessation of demand in the markets of North America, the heavy burden of war taxation and the loans necessary for national purposes, left manufacturers everywhere only confined means, and lowered credit. In the hosiery districts the warehouses were full of goods. How many thousands of times was that cry repeated—"Give us work at any price; half a loaf is better than no bread!" It was a heavy cry uttered too often ever to be forgotten. The years 1811-12 were sorely distressful, and even dangerous in a high degree throughout the three midland counties. There was as little unity of opinion amongst the hosiers as to the causes of the difficulty under which all were labouring, as amongst the men. The higher class of employers paying best wages and making the best goods, eschewing altogether the manufacture of the spurious cut up goods, laid the larger part of the blame on their lower competitors giving less wages, making worse goods, underselling them, and destroying what little confidence buyers who still possessed means had in making purchases. The misery of the poor

dependants on wages which when at work were reduced to an average of about 7*s.* a-week, but often not now in their power to earn, rapidly drew towards the point that passes endurance, as the close of the year 1810 approached. So great and rapid was its progress during the next year, that the number of unemployed families relieved from the poor rates of the three parishes in Nottingham on the 30th January, 1812, was 4248, including 15,350 persons, or nearly one half of the then population. For twelve months past many working men had swept the streets in Nottingham, Leicester, and Derby, receiving a scanty eleemosynary pittance for their labour. Threats of vengeance had been loudly uttered against hosiers paying reduced wages. Early in March, 1811, many of these men came in from all parts of the county, and proceeded to carry their threats into execution. There was an assemblage in Nottingham market-place. The military appeared, so there were no acts of violence attempted in the town. But sixty-three frames, chiefly belonging to Messrs. Bolton, were destroyed at Arnold that night. Two hundred more were broken in the next three weeks. These things were done no doubt by persons led on by able, daring, and resolute workmen. How many there were thus banded (as it was no doubt justly stated on oath), was never known publicly. It was believed the number was small of those actually engaged in the work of destruction, and that most of them were young. If so, they compensated by an activity almost ubiquitous for their want of numerical force.

But this would partly account for their unexampled secrecy, and the fact, that for years scarcely any were brought to justice. Samuel Slater, a frame-smith, was said to be a principal leader, if not general Ned Ludd himself—so designated from the act of one Ludd or Ludlam, a Leicestershire lad, who, when desired by his father, a stocking-maker, "to square his needles," *i.e.* to place them in a perfectly straight line in the front of his machine, took his hammer and beat them into heaps. There were said to have been four companies or gangs, one each for the districts of Sutton Ashfield, Nottingham, Arnold, and Swanwick. Frames

were sometimes demolished the same night at places twelve miles apart. They made their attacks in parties of from six to fifty, and seem to have implicitly obeyed the command of their leaders. Those on guard were armed with swords, pistols, guns, and other weapons; the actual frame breakers carried sledge hammers, axes, &c. After the work of destruction was done, the captain called them over by numbers, to which they answered, and on his firing a pistol, the men uncovered their faces and dispersed.

An effective military force of about 800 horse and 1000 foot, was concentrated chiefly in and near Nottingham, under the direction of several experienced military officers who had orders to consult with the local magistrates and two London police magistrates, specially sent down by government, to assist in every way practicable. Money was secretly offered for information; and a royal proclamation was issued offering £50 reward for the apprehension of any offender. Notwithstanding all these measures, the devastation increased in extent and violence as the winter came on, and many country frames were brought into Nottingham for safety.

In November, 1811, one Hollingsworth's frames were broken at Bulwell, and all the furniture in his house destroyed. On this occasion resistance was offered by discharging loaded fire-arms at the assailants, whereby one of them, John Westby, of Arnold, was mortally wounded. There was great excitement at his funeral; the riot act was read; the high sheriff, magistrates and military being present. The enraged rioters destroyed next day a waggon-load of frames near Arnold, and a few days after thirty-seven frames at Sutton in Ashfield, belonging to one Betts, whose factory they sacked. Soon after he died deranged. Here the Yeomanry Cavalry caught four frame-breakers—Bradbury, Marshall, Green and Clarke—who were committed for trial. Stacks were burnt whose owners were active members of that force. In the following week thirty-six more frames were broken. The magistrates published a letter which states:—

"There is an outrageous spirit of tumult and riot, houses are broken into by armed men, many stocking-frames are destroyed, the lives of opposers are threatened, arms are seized, stacks are fired, and private property destroyed, contributions are levied under the name of charity, but under the real influence of terror."

It goes on to point out—

"That all this tends to insurrection, and that it is their duty to suppress these evils by civil and even military force, and to cause the due execution of laws which will affect the lives of offenders."

This address had no effect in checking the outrages. In the last week in November, forty-five frames, chiefly making cut-ups, were broken at Basford, and others at Nottingham, Chilwell, Cossall, Eastwood, Heanor and Arnold. Upon this, the public-houses were ordered to close at 10 P.M. and inhabitants warned not to be out after that hour. The hosiers and lace manufacturers now felt sufficiently alarmed to hold a general meeting, at which it was resolved, "that if peace were restored they would be prepared to receive and consider proposals from their workpeople and remove grievances if any were found to exist." Twenty more frames were destroyed the following week, and the minds of the people were evidently inflamed by the tenor of the Royal proclamation. Farmhouses were plundered of provisions and money by men who declared "they would not starve while there was plenty in the land." It was in this last week of November, 1811, that the writer of these lines, then a youth of scarcely seventeen, was required by his masters to get into the saddle and make a long round, to convey the information that if their frames, of which they employed about 3000, were spared from the destruction with which they were threatened, one shilling per dozen advance would be paid the following Saturday, and be continued whether others paid it or not. It was a dreary afternoon with heavy rain and winter sleet. He rode hard, and at Basford, Bulwell, Eastwood, Heanor, Ilkiston, Smalley, Sawley, Kegworth, Gotham and Ruddington, delivered to their head frame-work-knitters the joyful news of the offered advance. The wintry storm, though uncomfortable enough to the messenger, tended greatly to the success of his message. It prevented for that night the maraud-

ing parties employing themselves; these frames had been undoubtedly doomed, for an example, as belonging to one of the most influential houses in the trade. The promise made was faithfully performed; not one of their frames was injured, and no further fears were excited as to the safety of their property. The author served for a whole year (at this time of alarm) as a special constable, and though so young had others, at first civilians and afterwards foot soldiers, to lead every second or third night. In the latter case six men armed with muskets were told off, and at 5 P.M. having received the instructions and pass-word from the sitting magistrate, he did the duty of patrolling with them in the town until six the following morning. The responsibility was new and weighty, and not altogether unattended with danger, the Luddites being armed; and knowing they hazarded their own lives, they were not chary of the lives of others. Their daring and courage were shewn in the instance of one who entered a house alone in Rutland Street, Nottingham, one evening; proceeded up stairs and smashed the material parts of a frame in a minute or two; but that short time was sufficient to cause an alarm; constables were in front of the house, and the author happened to be on duty, in Park Street, behind it. The man at once perceived his danger, threw himself on the roof; passing along others he saw in the dim light that the earth had been lately turned up in a garden below, and leaped from the eaves of a three-story house upon it. The frame-breaker quietly passed through a kitchen where a family were at table, and escaped. In a few minutes the shouts of a sympathising crowd were heard at New Radford, half a-mile from the scene of the adventure. Nineteen warp frames worth £200 were broken at Linby, and fourteen stocking-frames at Ruddington, with twenty at Clifton, in the first fortnight of 1812; also fifteen frames were destroyed at New Radford, nine at Basford, nine at Hucknall, five in Nottingham, and three at Butwell—sixty-eight in all; and the Sunday night following, eight in Nottingham in eight minutes. Wheat was now £5. 8*s*. per quarter, employment scarce, and there was great suffering. The

town of Nottingham seemed as if in a state of siege. A large subscription was now entered into throughout the county, for the purpose of stimulating endeavours to suppress these outrages. It was headed by the names of the Dukes of Newcastle and Rutland, Earl Manvers and Lord Middleton, with others of £500 each; Messrs. Sherbrooke, Manners Sutton, and many others, £100 each, &c.

At the March assizes in 1812, judge Bailey sentenced four frame breakers to fourteen and three to seven years' transportation—leaving the commission of assize open, that if needful he might return and administer summary justice on any delinquents. At the July assizes, one was sentenced to fourteen years' transportation and another to three years' imprisonment for frame breaking.

In March an act was passed, extending the punishment of death to any one breaking a frame employed in manufacturing any kind of material. In April, Mr. Trentham, a Nottingham hosier, was shot by two men, but not mortally wounded, while standing at his own door. They were never discovered, although £600 was offered for their apprehension. In November this year, Luddism became again prevalent, chiefly on Sunday evenings. Several frames were broken at Sneinton; but a bold defence of some others, made by Mr. Black, caused the practice again to cease for a time.

When the government brought in the Bill which made breaking frames punishable with death, Lord Byron strongly opposed it in a debate which took place in the House of Lords, 27th February, 1812. In this, his maiden speech, he forcibly described the condition of things then existing around and in close proximity to his own dwelling, Newstead Abbey. His Lordship said—

"To enter into any detail of the riots would be superfluous, the House is already aware that every outrage short of actual bloodshed has been perpetrated, and that the proprietors of the frames obnoxious to the rioters, and all persons supposed to be connected with them, have been liable to insult and violence. During the short time I recently passed in Nottinghamshire, not twelve hours elapsed without some fresh act of violence; and on the day I left the county I was

informed that forty frames had been broken the preceding evening, as usual, without resistance and without detection.

"Such was then the state of that county, and such I believe it to be at this moment. But whilst these outrages must be admitted to exist to an alarming extent, it cannot be denied that they have arisen from circumstances of the most unparalleled distress. The perseverance of these miserable men in these proceedings tends to prove that nothing but absolute want could have driven a large and once honest and industrious body of the people into the commission of excesses so hazardous to themselves, their families, and the community. At the time to which I allude, the town and county were burdened with large detachments of the military, the police were in motion, the magistrates assembled, yet all the movements, civil and military, had led to nothing. Not a single instance had occurred of the apprehension of any real delinquent, actually taken in the fact, against whom there existed legal evidence sufficient for conviction."

During these excesses in Nottinghamshire, though few frames were broken in Leicestershire, yet the spirit of discontent was equally active there, but it shewed itself in a far more rational form. During the disturbances which prevailed, producing great alarm amongst the resident nobility and gentry, as well as all persons of property and others peaceably disposed, Mr. Gardiner relates, in his *Music and Friends*, vol. I. p. 476, that—

"Being at Wigston Hall, Lord St. John enquired of him their cause; to which he replied, 'a party was going about drawing out and taking away the jack wires from the frames of *those working under price*.' This act renders a frame useless for the time, but does not injure it; and when restored, the part may be replaced in the frame, by a competent person, in a few minutes time, so that it may be set to work again. Jack wires had been drawn and deposited in the churches at Arnold and elsewhere, before the more decisive step of destroying the frames was adopted."

During the same year, 1811, Gardiner, being in London to oppose as a hosier the proposed bill for legislatively giving powers to fix the fashion and price for making all kinds of frame-work knitted goods thereafter to be made, had an interview with the Archbishop of Canterbury, Dr. Manners Sutton, the representative of an ancient Nottinghamshire family, in the course of which his Grace said, "I am much alarmed at these Luddites, and fear they will produce a commotion if they are not speedily put down." A fear which pervaded for the time the whole kingdom. Gardiner replied:

"It is to be lamented that the operatives entertain very wrong notions about the improvements in machinery; and I am sorry to find well educated persons join them in saying they are injurious to their interests. Genius is not to be stopped in this savage manner. If invention is not allowed to work here, it will be carried abroad and ultimately destroy our trade."

Upon this subject an old and experienced Leicestershire stocking-maker remarked, "Frames were broken in 1811-15, not on account of disputes about wages, but of cut-up work, which lowered the demand for fully wrought goods, and so tended to reduce prices generally."

In October, 1814, the house of Mr. Thomas Garton, at Basford, was attacked. This person had caused the apprehension of a sworn Luddite, James Towle (afterwards hanged at Leicester) and being in expectation of this visit, he had obtained the assistance of several constables who were then with him. Several shots being fired, they fired in return, when Samuel Bamford, one of the assailants, fell. The rest in retreating shot a neighbour, Mr. Kilby, dead at his own door, which he had opened on hearing the report of fire-arms. Some wide frames making cut-up work were broken in and near Sutton in Ashfield about this time.

A long cessation of Luddism ensued, until, in the night of the 18th of June, 1816, nineteen lace machines were broken in the shops of William Wright and Thomas Mullen. Two men were tried for this offence, and saved by their counsel, Mr. Denman, successfully pleading an alibi. If they had been convicted the judge and jury were to have been shot by armed men, many such being in the court.

Whether the daring character, the extent of property destroyed, or the consequent dreadful results to the culprits, be considered, the attack on the factory of Messrs. Heathcoat, Lacy, and Boden, at Loughborough, which took place in the night of the 28th of June, 1816, was one of the most deplorable of these memorable affairs. Fifty-five frames were destroyed of the value of £8000 or £10,000, and the lace upon them was burnt. But the most serious and fatal part of these proceedings to the prisoners ultimately tried, was the "firing a pistol at John Asher, one of the workmen in the place, with intent to kill him." James Towle, who had been pre-

viously tried for frame breaking and acquitted, was found guilty of this attempted murder at the Leicester Assizes in August, 1816. He was executed in presence of an immense multitude, shewing undaunted self-possession, repeating and singing a hymn with seeming fervour.

Daniel Diggle was convicted at Nottingham, in 1817, of shooting George Kerrey, at Radford, in December, 1816, and wounding with intent to kill. He had pleaded guilty, and deplored on the scaffold his association with Luddites, thereby disobeying the commands of his parents.

The same year, at Leicester, eight men, Savidge, Withers, Amos, Watson, Mitchell, Caldwell, Crowder, and Clarke, were arraigned for the attempt on the life of Asher at Heathcoat's factory. John Clarke was tried alone, on account of the challenges exhausting the jury list. On this occasion there was the additional evidence, such as it was, of Blackburn and Burton, two accomplices, given avowedly to save their own lives. It seems from the statement of the first of these, and who appears to have been an active man amongst the managers of the frame breaking conspiracy, that £18 was given Withers, (who probably led the party and was one of the prisoners), with which to buy tools and fire-arms for the rest; £40 more was promised to be paid when the frames were broken, and £60 more to be collected and distributed among the men actually engaged. Savidge was active in the money part of the affair. "The Radford job had not yet been paid for, though promised; and none but *old* Neds" (men who had been thus employed before) "would do for this expedition," which was felt to be one of hazard, requiring the utmost boldness and experience. Seventeen names were enumerated as forming this picked party. The jury found Clarke guilty; as did another jury the next day the seven others. A woman, whose husband was a workman in the factory, gave evidence, that hearing the noise of frame breaking, she went into the street, and being laid hold of by Savidge, one of the prisoners, asked him why they broke the frames? He answered, because Heathcoat's men were working under price. On which

she replied, the men were satisfied, and they had no business to break the frames. She swore to the identity of seven of the men charged.

Being found guilty, six were hanged and two were transported for life. The former shewed great firmness, addressing the spectators, and all joined in singing a hymn, one repeating it for that purpose. Fifteen thousand spectators witnessed the execution. After this scene Luddism seemed to have become extinct; no frames being broken in these parts for several years. About one thousand stocking-frames and eighty lace machines were destroyed during this outburst of popular frenzy.

The practice extended into the northern counties, it was professed on account of the increase of machines directly calculated to supersede manual labour. In regard to the object had in view by the Nottinghamshire frame breakers, opinions at the time and since have much varied. Probably there were various hopes entertained by the multitudes around, who sympathised undoubtedly with the movement, though they stood aloof from personal efforts to promote it. The broad substratum of the whole of this wretched heap of wrong-doing was undoubtedly the hunger and misery into which the large portion of the fifty thousand frame-work-knitters and their families were fallen, and from which they never fully emerged for the following forty years. During that long interval, the average of the frame-work-knitters clear earnings by long hours of labour did not exceed six shillings a-week.

It was upon the occasion of the condemnation of the eight men at Leicester, that G. Henson and William Robinson took up to London a numerously signed petition for mercy, but before it could be presented, Henson was arrested, examined before the council, and confined seven months in Coldbath fields as a state prisoner, on suspicion of high treason.

Amongst the papers on trade subjects which Grovenor Henson left behind him, is one, which if true—and there seems no reason to doubt it, as to the main facts related—throws considerable light on the question how this bobbin net frame breaking originated and was carried into effect. The paragraph is as follows:

"The patent machines were worked by hand; in a few years wheels were put in to work the carriages by machinery, which improvements doubled the speed, and these machines were called 'Loughborough improved.' But even then, the patentees were pressed by the warp Mechlin nets, and had to reduce wages one-third. Upon this the (Nottingham) warp committee confederated with Lacy's Loughborough hands and the turn-outs; and the resolution was taken, though it was then in the midst of summer, to destroy his machines. This was effected. Heathcoat was obliged to build entirely new machines."

Lacy's hands referred to, were probably point net or warp lace workmen. When Heathcoat's patent traverse net factory was established, the newly sprung up manufacture of warp lace was making rapid strides towards taking the place of the decaying trade in point net, and absorbing the hands, gave a very high rate of wages, therefore these workmen could well afford funds; and to destroy so formidable a rival as the twist net patentee, they would be very likely to find the money. About £120 in all was promised for this business, and another recently performed was yet owing for, shewing that in both trades, hosiery and lace, when it was a question of breaking frames, the work was done for hire. No doubt the committee would select the 'old Neds' most suited for the purpose. The members of these trade societies were at that time and for twenty years after, bound together by secret oaths, and their leaders acted with most despotic power. It is not too much to say, that there was no trade combination in the three midland counties during the first forty years of this century with which—though he might not, and in this instance doubtless did not, take a part—Henson was not acquainted, both as to their leaders and designs, and in due time their operations. Thus, before the first frames were broken in March, 1811, at Arnold, at a conference with Brocksopp and other hosiers, it had been agreed "to give the men *un*abated wages, provided they would join in bringing up the under paying masters to the same standard and to put down cut-up work." Henson expresses, in his manuscript account, great indignation because the men in this instance would not carry out the plan—which if he did not devise, he strongly approved—but went and broke Brocksopp's frames amongst the first batch at Arnold.

In various conversations twenty to thirty years after, he recounted at some length the fears and hunger and thirst of four of the men amongst the seventeen who made the attack on Heathcoat's factory; who lay concealed, he said, the whole of the following day in the long grass then covering Loughborough meadows, not daring to stir from under the burning sun till night, and then not venturing to cross the bridge over the Soar, or through the toll bar at Cotes, for fear of detection, taking bye-paths along the river by Zouch Mills, there crossing it, and so pursuing their course over Red hill, crossing by the Trent ferry at Barton they took their way along the bank, till they reached Nottingham and their homes. The names of three of these he mentioned, whom he described as having been deeply implicated in most of those acts of violence since 1811; but who on effecting this escape, and the equal danger of being denounced by approvers on the trials of their comrades, separated themselves from all lawless courses ever after, becoming wiser and sadder men. One of them lived until a few years ago, employed as care taker of valuable stock in a warehouse, and was a faithful and trusty servant. He wrote, it is believed, a full account of what he knew of Luddism, to be read after his death. But the paper, if it exists, has not been accessible to the author, through the sudden and lamented decease of the late Alderman John Bradley, of Nottingham.

The name of the fourth frame breaker who escaped, Henson would never reveal, but promised to leave behind him "an historical account of Luddism," of which, if he should die first, the present author might avail himself. Such a document has not been found, which is much to be regretted, as its contents would have been both curious and valuable. So much was gathered from Mr. Henson, notwithstanding the decided repugnance he usually shewed to enter into details on this subject, as to make it quite evident that the executions, which took place in 1816-17, were, in his opinion, the efficient cause of the disappearance of Luddism from the midland counties.

The proprietors of the machinery which had been

destroyed at Loughborough, sued the county for the damage, which on an enquiry ordered by the King's Bench, it was decided must be paid to the amount of £10,000. The magistrates required that the sum when handed over should be expended locally. To this Mr. Heathcoat gave a decided refusal, and the amount was never received. He said that "his life had been threatened; and he would go as far off as possible from such desperate men as these frame breakers were." He agreed with Mr. Lacy that their future course as to the erection of new machines should be distinct; and in conjunction with Mr. John Boden, of Loughborough, who had become a partner and the director of the sale of their lace goods in London, a purchase was made of a large mill at Tiverton in Devonshire, where machinery could be driven by the powerful stream of the Exe. This building was restored and enlarged, and the construction of rotary *power* machines was *at once* commenced and vigorously carried on until in the end three hundred were at work there. This decision, directly consequent upon the unlawful and deadly violence of a combination of workmen, has already deprived the midland district of the employment and profit derived from six or seven hundred machines, during the fifty years which have since intervened. Comment on such a fact is unnecessary.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CHAPTER XVII.

MR. JOHN HEATHCOAT.—1816 TO 1860.

THE events which had just transpired at Loughborough proved in their results to be the turning-point in the life of the bobbin net inventor, by fixing him in a new sphere, employing improved machinery worked by new and inexpensive motive power, and in the midst of cheap labour freely employed. He set himself vigorously to work for the improvement of these advantages. The description of several modifications of his machinery, made by others since that of the traverse warp, has been postponed, with a view not to interrupt the relation of Mr. Heathcoat's course. The like plan will be pursued as to the other more important inventors, whether in hosiery or lace.

The next machine patented by Mr. Heathcoat was in 1816, No. 4037. He describes himself as late of Loughborough, now of Tiverton, lace manufacturer. His accurate knowledge of the construction of Lee's stocking-frame is not only demonstrated by the way in which he deals with its various parts in this ingenious modification of it, but he boldly subjected it to the processes necessary to produce the mechanical narrowing of the web, in place of performing it as hitherto by hand; and, in addition, added rotary motion to it. This attempt, forestalling by thirty years the course of adaptations and improvements, which have been successfully carried out for the like purposes only since 1845, was meditated and executed just at the time when his bobbin net machinery was destroyed, and when he would be deeply engaged in replacing it by other frames on improved models. In this specification of a modified stocking-frame, after giving a clear and succinct descrip-

tion of the working of Lee's machines the following new arrangements are set forth:

The placing two or more sets of needles in a frame over each other, so that one set of jack sinkers and one set of lead sinkers will form loops on each row at the same time. Also dividing the sinkers into two distinct parts, the one part applied in front of the needles, and the other he calls hooks. There is a further combination of parts described as thread layers, used so as to lay threads for the supply of several tiers or sets of needles, and of passing the threads between the needles so as to narrow the web on each edge, thereby enabling the machine to produce two or more webs at once in different heights or tiers by one set of jacks, and narrowed where desired. Also, finally, by a suitable arrangement, causing the machine to work entirely by the revolution of one pulley or drum.

In the same year 1816, No. 4078 was taken out; and before proceeding to state in it the further improvements he had made, Heathcoat described the modified operations up to that time of his bobbin net machines—

As seen in the fetchers and shifting bars, in the action of the feet; in the method of moving the brasses between the beam threads; and describes five movements to pass the back division of brasses between the beam threads from front to back; and seven more to pass the front division to the back, then five to return the back division to the front, and eight to cause the front to follow them. Also machinery for shogging guide bars; and for acting on the points in crossing and taking up meshes; and for better producing the turn again and selvage.

The improvements claimed in this patent are: a new application of added parts or guides to supply gimp threads to ornament the lace as it is worked. Applying machinery to give such motions to these additional guides as will direct and interweave the gimp according to the desired pattern, laying it along the sides of the meshes, not twisting the mesh threads round the gimp, but passing it longitudinally, diagonally, or horizontally. Also machinery for interweaving cloth work, either every course or discontinuing it to suit the pattern.

In constructing the new machinery necessary to fill the Tiverton mill, Mr. Heathcoat arranged it so as to be actuated by the inanimate rotary power supplied by water and steam. This relieved the workmen from any labour but that of controlling and supplying them with materials. In thus making way for the general introduction of the factory system into this manufacture, he was followed immediately by Lindley, Morley, Sewell, Jackson, and Henson of Worcester.

The infringers upon the patentees had been rapidly increasing, and the effect upon prices of their added

production to that of Heathcoat, had become such in 1816, as before the destruction of his machines, to require him to reduce his high rate of wages. Each of his foremen were permitted to have two or more machines of their own worked in his factory, the produce of which he took, paying them the prices at which his own goods were calculated before finishing. They paid their journeymen such wages as were received by the rest of the hands. The reduction of wages brought the latter to two-thirds of the amount they once received. This, together with the difference of their position to that of the overlookers, caused dissatisfaction, and a turn-out of some. Mr. Boden, however, brought down finished goods bought in London with the invoices charged at such prices as convinced those hands who were out, that the infringers who had supplied them were greatly underselling the Loughborough production. They returned therefore to their work. Mr. Heathcoat was at the time in Devonshire, where he accidentally saw the mill, afterwards so unexpectedly purchased by him. This partial expression of dissatisfaction gave an opportunity for the trade interference from Nottingham. Mr. Boden was on the point of leaving for London, and had just quitted the mill with Mr. Hallam, when at midnight they heard a shot fired, and two of their men came to tell them that the machines were being broken, and that Asher was shot.

Although for a time the Loughborough hands were thus entirely thrown out of work, the best of them were retained and transferred to Tiverton. There the greater part of them remained till old age or death, in the employment of Mr. Heathcoat, to whom they were greatly attached. Mr. Ferguson justly says, "Mr. Heathcoat was surrounded by a little world of workpeople, who loved him like a father." There were at the time of this exodus to the west of England of the patentee and his people, 156 infringers; viz. 116 lace and hosiery manufacturers, 31 frame-smiths, 2 watchmakers, 2 blacksmiths, 1 victualler, 2 butchers, 1 coal dealer, and 1 joiner.

The result of the trial above related, enabled the patentees to direct their attention to the important

question, how this body might be most satisfactorily dealt with. Their number having increased to upwards of 200 in 1819, the patentees commenced actions against about thirty of the principal ones, and filed declarations against about twelve. It was to hide from notice at this time, that seven old Loughborough frames were placed in a garret in Houndsgate, and lay forgotten until 1846, when they were thrown to the scrap heap, before we heard of them: none have been seen since.

Amongst the latter number of infringers were Grace, Berridge and Stanford, who were in partnership at Kegworth. With them Heathcoat determined to try the question, because their machines were constructed (with trifling deviations) upon the model of his own. Berridge having been one of his workmen at Loughborough, and for some unexplained reason left behind, at once entered into an engagement with Stanford, a gentleman of property at Kegworth, and Grace, whose father resided at Quorndon, and himself was a captain in the army. Besides these who were rapidly building machines, ten framesmiths were then ascertained to be under contracts for one year, and one for seven years, doing the like and displaying great skill. The disabled state of the patentees to supply bobbin net, which was from time to time in great demand, gave an irresistible impulse to making machines. The trial against Grace and Co., took place in Easter term, 1817, in the Common Pleas. The damages were laid at £10,000. A verdict was given for Heathcoat, subject to a reference to Mr. D. Pollock. The plaintiff, however, wishing only to secure his rights, declined to press for damages.

This trial established in a direct and positive manner the validity of Heathcoat's second, or 'old Loughborough' patent. It was then ruled—

"That inasmuch as it required a division of threads into two systems, it was of no matter which was made to traverse, whether the warp or the bobbin. And further, as to John Brown's machine and any other, Heathcoat claims against all infringers that his is an engine whether of parts used before or those new and peculiar to his machine, that it is a perfectly new conformation of parts, entitling him to a patent according to Chief Justice Gibbs, in Bovill *v.* Moore; Brown should have renounced the old parts and claimed only those he

had invented. But taking a part of Heathcoat's conformation into his engine and claiming for all, his specification is bad, it being only an improvement of another's invention, which tried by this test is a perfectly new conformation."

The expectation of this trial caused great excitement and some consternation in the trade, which increased after the verdict and pending the award. The action had been defended by the assistance of a trade committee backed by a large subscription, and represented in London by deputies in the conduct of the defence. An infamous handbill printed in the country was distributed in the avenues to the court on the days of the trial. Mr. Heathcoat had received overtures from many infringing parties, who were desirous of obtaining licences, and had agreed to grant them. He staid the actions against others, wishing to save expence to all parties, and to calm the apprehensions of further litigation. When the award was made Lord Chief Justice Dallas said—

"I know the system of terror that reigns at Nottingham, and that it is necessary to shew those who conceive that they can set the laws at defiance, not only that the laws will reach them, but that when it is proper there are those that will enforce them. Now that the cause is at an end, it is my duty to say that I have received this moment a paper, of which I have only had time to read enough to see that it is a most criminal attempt to interfere with the administration of justice by representing persons who by the exercise of their ingenuity have entitled themselves to patents, as monopolists endeavouring by their conduct to oppress the poor. Into so wide a subject as the operation and effect of machinery, I am not about to enter; but this I will say, that after the temporary inconvenience which is felt from what I would call the shifting of the scenes, whatever tends to abridge labour is in its result greatly beneficial to the public; and patents of this nature would never be granted unless they were of public utility. Having said this, I think it necessary to add that persons who have, at the door of this court, distributed a paper of this description, if discovered, ought to be prosecuted; and I recommend that an attempt to discover them be made, and if so, that a prosecution may be accordingly instituted."

No further proceedings were however taken, and the effervescence of feeling gradually calmed down.

The result of what had already taken place was to bring about a kind of general compromise, to which however there were a few exceptions amongst infringers. Licenses, containing permission to work the machines named in them, with other ordinary covenants, and

constituting the Deputy Recorder or his nominee the general and binding referee in cases of dispute, were granted for about six hundred and ninety-six machines, by March 21st, 1818, as stated by the patentees to Bovill; ninety of them being to himself, Brown, Freeman, and Aguttar. The licenses then produced about £10,000 a year, and so continued to do until the end of the term. Many of these licensed machines were in the hands of capitalists; but others were the property of persons who worked in them themselves, or who holding two or more had relatives as journeymen, but being without further available means must sell the lace net to the warehouses. The total quantity made was greater at times than the demand for it, and in consequence the article was much lowered in price. This seriously affected the interests of the patentees, who had difficulty in getting license money paid in, besides their production, as well as that of all others, being much reduced in value. A general meeting of patentees and licensees determined to enter into mutual arrangements in 1819, by a deed binding on the part of the patentees to grant no new licenses; and on the part of all the holders of licenses as well as themselves, to raise a fund to be subscribed *pro rata* according to the number of quarters worked by each. Under this deed a 'mart' was established, a secretary appointed, and the patentees, six other larger owners, and six representatives of the smaller licensees, were chosen and constituted its trustees and managers. It was calculated that a fund of £10,000 could be raised. The first year's contributions were under £3000.

The plan was, for the association to buy at prices to be fixed from time to time by the managers, any lace net made on their machines and brought to it for that purpose by any of the parties to the deed. The contribution to the fund was fixed at two pounds per quarter in width of each of their machines, which might be represented by notes of hand for the amount. Lacy bound himself not to go beyond his 127 machines, and Heathcoat his 147 machines. All parties were to use their efforts to prevent further machines being constructed. It was agreed also to pay on the requisition of the committee, a further sum of one pound per quarter of width, and finally threepence per quarter in width *weekly* while at work, during the continuance of the patents. The sums thus raised were to be used in buying up lace from the contributors, and in paying expences. The committee of which

the patentees were permanent members changed half yearly by three going out, their successors were elected by ballot; five to be a quorum and to them was given full power to transact all business, with the proviso that any goods sold on credit must be by permission in writing of the patentees and a majority of the committee: and that of all debts, credits, and assets, a faithful account should be kept in the books, in connection with the deed. At the expiration of the patents in 1823, the stock and debts of the 'mart' were to be forthwith realised by the committee, and the produce employed in paying the money subscribed. Any surplus to be divided amongst the workmen employed; if any deficiency, a rateable proportion to be charged on the contributions, but legal proceedings to recover to be restrained for twelve months thereafter. The committee were not to be liable for any losses except from wilful neglect, nor for each other, nor to be considered or constituted partners. The rules might be varied by a majority at a public meeting, provided the patentees and a majority of the committee agreed to them.

This document was signed by the two patentees, holding 274 machines and about 1918 quarters in width; eighty-two manufacturers with 1261 quarters; and eighty-two smaller owners with 557 quarters. The patentees machines were from five-quarter to eight-quarter, those in other hands from three-quarter to six-quarter in width.

The deed had not been signed by all who were become possessed of machines, and the few who were thus unlicensed infringers, gave no small trouble to those having heavy tribute to pay. The latter called on the patentees to protect them from this competition and secure to them their gains. More machinery also continued to be added, the produce of none of which would come into the 'mart,' but be sold at lower prices in the open market. A bill had been filed by the patentees before this association was formed, but still pending, for an injunction, in which an affidavit was made by Heathcoat that "by the use of his invention he supplied the market with large quantities of his lace at *reasonable prices*." Moreover other bills must now be filed for injunctions to prevent further making of these patent machines. But the objections made to these proceedings were weighty; and before long a question was raised as to the legality of the 'mart' association. For though the mart prices might not be unreasonable, yet no doubt they were higher than could be got from buyers under ordinary circumstances.

The intention of the association was carried out by keeping up prices beyond what the article would otherwise produce. Therefore it was objected, 'that it was illegal, the public having a right to buy at the fair market value, as regulated only by the necessities of the makers and the purchasers.'

Its legality was defended on the ground 'that its continuance was made to depend on the expiration of the patent: and that the association kept up the price of an article which the patentees could fix at any price they pleased during the patent.' The answer was made, 'the patentees are bound to serve the public at fair and reasonable prices; and as they have chosen for their own purposes to license so many competing machines, the article ought to be sold without the intervention of any association, or fixed at such prices as it will produce in the usual course of sale.'

Most parties seem to have admitted the illegality of such an association respecting any other than *machine wrought net, the subject of this patent;* but the opinions of some eminent men were said to vary on this point. The patent gives no rights beyond the particular kind of machine described in them. The article itself had been long made by hand on the pillow.

Therefore when the point arose, 'was the association an illegal combination?' the Solicitor General Copley, in consultation with Hart and Bell, replied, 'we are inclined to think the association founded on the deed and regulated by its provisions is *not* an illegal combination.' As to some other points, they were of opinion that 'the deed was not a breach of the proviso in the patent limiting the number of persons to be interested under it, nor did it prevent Heathcoat from applying a new moving power to his machines; nor would the deed affect his successful application for an injunction against infringement.'

In 1817 journeymen received 1*s.* per rack per quarter of a yard in width, and the net they made sold for 5*s.* per rack per quarter. In 1820 these prices had fallen to 4*d.*, and in 1823, 2*d.*, to the journeymen; and the net in 1820, 1*s.*, and 1823, 6*d.*, the rack per quarter to the masters. The number of machines had increased so much that the owners now preferred to be under license, provided more were not constructed. In 1820, one thousand and eight machines were licensed, and the licensees themselves proposed that the tribute should be made £5 per quarter in width of each machine for the year. Journeymen paid £50 for a year by £1 per week to be taught how to make bobbin net. When the demand fell off occasionally, the production was stinted for a time. The warp lace frames were in 1823 making such expensive goods as to use chiefly No. 190 cotton yarn at £2 per lb.; some consumed finer numbers, paying for them from ten to thirty guineas per lb.

Meantime Mr. Heathcoat continued—in the midst of all this excitement, and the necessary labours of his enlarging affairs, mechanical, commercial, and legal—to read and study as assiduously as ever. For some years he had been preparing, by the acquisition of a correct knowledge of the French language, to enable himself to carry out any business operations across the Channel. Such took place in 1818, when he established his machinery, *working by steam*, at Paris, and in which he is said to have embarked, first and last, at least £50,000. He was well acquainted with Italian, and it has been said he was versed in Latin. The latter is however incorrect. He began to lay a foundation in 1818 for a good collection of English and foreign works on the constructive sciences.

The machinery for making lace, just referred to, was transferred from Paris in 1826, to large and commodious premises at St. Quentin, where great additions were made to its numbers and power of production. There were at one time 150 to 170 machines, giving employment to a large body of workpeople. When this factory was visited in 1849 by the then President Louis Napoleon, he expressed his admiration at the intricacy of the machinery and the skill of its inventor, with his approval of the public spirit which actuated Mr. Heathcoat in that time of agitation and change, deciding him not to cease the regular employment of his numerous and effective, as well as peaceful artizans. The operations of this establishment were carried on until the death of its founder, since which, they have been almost entirely brought to a close.

One of the defendants, Mr. Grace, in the action of 1817, became soon after a partner with Messrs. Heathcoat and Boden, but in a short time quitted them. The partnership with Mr. Boden also was dissolved in 1826, when Messrs. Boden and Grace united their interests in machinery—a connection which was not of long duration. On their separation, Mr. Grace took his bobbin net frames to Rawleigh mill, Barnstaple, which, under the care of his partner Mr. Thomas Heathcoat, was worked until absorbed into the Tiverton business after the death of the latter. Mr. Boden having disposed

of his share of the machinery to Mr. John Miller, settled at Derby; and, being well versed in business, from his long experience and possessing both talent and capital, he proceeded to lay, in conjunction with Mr. William Morley, who joined him in partnership there, the foundation of an extensive manufacture of bobbin net, where for many years about 170 machines have been at work. These were built under the able instructions of Mr. Morley, of first-class widths, amount, and quality of production. Of this mechanician more will be said in a separate form. Mr. Boden's family connections alone carry on the business of this important establishment, which has always been employed in the fabrication of plain cotton nets. The Messrs. Bodens purchased from Mr. Morley his share of it, for, it was stated, about £70,000.

The expiration of the bobbin net patent, was precisely the period of national excitement in trade, as well as local activity in manufacture. At Nottingham, and throughout the whole district round, one of the great objects of every one's life, seemed to consist in seeking to become proprietors of machinery. Singularly enough, Mr. Heathcoat was at this exciting epoch as much engaged in devising inventions and improvements in other departments of manufactures, as in that of lace, hitherto almost engrossing his attention. Patents on some of each class followed each other in rapid succession.

Among the diversified mechanisms which were thought by Mr. Heathcoat susceptible of improvement, was the machine for platting various materials, such as silk, cotton, and other threads. After giving special attention to the processes in use, he patented in 1823, No. 4867, the following new arrangements of a platting machine:—

1st. The distribution of the system of barrels in one line, whereby a number of these systems may be put side by side, forming a compact series of any required number, all actuated at once, or any portion may continue in action, while the others stop.

2nd. Making all the axes of each set point to one centre, whereby the threads from the bobbins are of the same length, and do not alter their tension by changing their places; and the required angle at which the plait folds over the margin, is determined by the segment of the circle in which the bobbins travel from one end to the other.

3rd. Simplifying or reducing the number of tumblers, by the under and over lapping of the barrel rims which carry round the spindles and bobbins.

4th. By the flat arrangements of each series the breaking of any thread immediately stops that set by its action on the bar, throwing the wheel out of gear.

In the second of these modifications, the simple and important principle introduced into his lace machine, of working on a segment of a circle to give out materials equally in relation to a common centre from a number of sources, is reproduced in making articles of a widely different texture and character.

The manufacture of salt had engaged Mr. Heathcoat's attention for some time. He caused extensive enquiries and many experiments to be made at considerable expense in time and money. These issued in a patent taken out in 1823 by Mr. Josiah Parkes.

The invention consisted in a combination of a boiler with a vessel placed under it, and below the action of the fire, so as that the salt may be deposited within the vessel as it is produced, and withdrawn therefrom without interruption to evaporation, or opening the boiler if a covered one. Also for cooling the salt collected, by using cold brine.

His first invention in 1824, No. 4896, was for ornamenting goods manufactured from silk and other materials; but did not proceed to specification. Then he patented No. 4917, a method of forming and finishing carriages used in the bobbin net machine, by stamping them out in dies instead of filing them out to size and shape, as previously practised. This plan was soon universally adopted in the trade.

No. 4918, in 1824, was a patent taken out by him for improvements in rotatory bobbin net machinery, and in manufacturing certain parts of these machines. 1st. An apparatus for giving off warp and taking up the lace so equally as to give invariable form and size to the meshes throughout the piece. 2nd. For machinery for cutting out the combs used in bobbin net frames.

Of the same date is another patent, No. 4919, which caused much remark at the time, and though never carried into effect, is in more than one respect worthy of notice in the biography of the inventor.

He described it as an improved and economic mode of combining lace or other machinery worked by power

in spinning and weaving. It was upon what has been known as the 'Panopticon' plan; but only as to the power of general survey over the whole or nearly the whole of the machinery from one spot in the interior of the building. It was designed to diminish the cost of erecting factories; and to improve the warming, ventilating, and lighting of such places, and to give greater steadiness to the machines themselves when at work.

The machines were to be so placed and combined or connected, as that one tier or circle on the ground floor might support a second series; the second a third; the third a fourth, &c.; and this without pillars, arches, beams, joists, or floors of any kind, as a basis on which to place the several radiating superincumbent tiers of machines. The whole body of machinery was to be tied together so as to form one firm connected fabric or structure, without any dependence on the walls of the building surrounding it. The machinery was to be worked by an upright central shaft, operating by horizontal shafts upon the individual machines comprised in each tier. The overlooking was intended to be central also.

Again, in 1824, Mr. Heathcoat devised and patented No. 4926, an invention of a core or conical form of paper, cork, &c., on which in spinning cotton, wool, or silk, the roving or yarn may be wound into a cop. Also an eccentric pulley, drawing the carriage in at a variable speed.

And finally, in this year, he took out No. 4966, for improvements in the method of preparing and manufacturing silk for weaving into cloth or net. These consisted in a machine for combining into one continued operation, the processes of drawing off the silks from cocoons, and of twisting it into a thread without the intervening hanking and winding operations.

The ends of cocoons being united into one thread, this is carried to a spindle and flyer by which it is twisted; it is then wound upon a bobbin. By this mode 'singles' are made. The two or more threads for 'trame' may be in like manner separately drawn from the cocoons and twisted, care being taken that the separate threads converge equally to the guide forming the point of junction.

A further improvement was effected in 1825, patented No. 5200, in this machinery for throwing silk. The plan was not found to answer in regard to more than one important point, when tried in France and Italy. The twisted threads going on the bobbins wet from the

basins, required to be immediately re-wound into hank to prevent its caking together in drying, and so being difficult if not impossible to be separated. The loss of time in putting on the twist was so great as to lessen the gain obtained by getting rid of the intermediate processes. It never became general in Europe. Many thick sewing silks were thus made in the United States; and the machine is figured and described in several of their publications on silk growing nearly thirty years ago. It was shewn, with the original diagrams from the above patents, by the author, in lectures delivered by him at the Athæneum and Mechanics' Institute in Manchester at that time. Yet Mr. Dickens, about 1854, on behalf of Mr. Chadwick brought out the plan as a new and important invention, calculated to revolutionize the silk manufacture.

In 1825, No. 5080 was added to Mr. Heathcoat's list of patents, being for improvements effected in the circular bolt double tier power bobbin net machinery, by the combination of two additional locking-bars and the cams necessary to move them with the locking and driving-bars in common use in these machines.

The next patent in this year was No. 5093, for improving the reeling of silk and its quality.

By drawing off the silk filaments from the cocoons in larger numbers, but divided into separate smaller sets in the basin and up to the first guide wire, where the filaments of each smaller set are united. From these first guide wires as many of the smaller sets as will be necessary to compose when united, the size of silk thread desired for ultimate use, are taken through a second guide wire further on towards the reel, in front of which are placed the third guide wires to conduct the thread upon the reel and form the skein of raw silk. Before this takes place, however, a second thread similarly composed is brought from cocoons at the other end of the basin; and to incorporate fully the numerous filaments in each, by pressure of the warm and softened gum with which each is covered, these two ultimate thicker threads are passed round each other, and then separated before passing singly upon the reel. The surplus gum is forced out according to the number of twists given; and the thread may be wound off the skein with much greater rapidity than when reeled of the old fine sizes, and with much less waste. The expence of winding and then doubling fine silk threads is also saved.

This plan is to wind the cocoons in small numbers, as 4, 5, or 6, to each thread, but instead of taking it to the reel in this size, to reunite 2, 3, 4, or any number

of these smaller threads into one, before they arrive at the second guide wire. The woman at the basin has to keep up only the smaller number correctly, and can thus make the ultimate thick thread as even as the finest ones.

By this very simple arrangement, most important results were obtained. Previously, to obtain an even thread of 15, 20, or 30 cocoons in size, raw silk of 5 cocoons was reeled; the skeins were then wound on bobbins, and the threads from 3, 4, or 6 of these united in one; and after all the quality of perfect evenness was not so well secured, as by this patented method, while the serious expenses of the two last windings, with all the attendant waste, are by the new process saved.

The idea of this obvious improvement occurred to the mind of the author (who had spent the previous year abroad on Mr. Heathcoat's account in practical enquiries about silk reeling) while conversing with him on their way to Paris, upon the importance of getting heavy raw silks evenly reeled; and he proposed it for further consideration at the end of their journey, as he could not but suppose a method so easy and safe must have been thought of and practised before. But Mr. Heathcoat at once saw and sketched out how it could be done, and the next week the specification, written by himself with a drawing, were deposited at the French patent office. The author then again visited the Cevennes; and introduced the plan to M. Tessier, of Vallarogue; who, by his own freedom from prejudice, overcame the intense disgust at first felt by the silk reelers at the innovation, and reeled that season, 1825, about £5000 worth of 3-strand 5-cocoon silk, which gave a beautiful thread of 15-cocoon silk suitable for and worked up into bobbin net lace, partly in Paris and partly at Tiverton. No time was lost in taking out patents for Italy; and the same season the author was enabled to get the plan put into operation by one of the most extensive silk reelers and merchants of Milan, M. Dominique Staurengo, at his Cernusco filature. Mr. Heathcoat made arrangements for a constant supply from filatures of his own in the Milanese and elsewhere—

a plan pursued in his business down to the present time. The author obtained 35,000 lbs. of cocoons, in 1825, from Florence, took a young Englishwoman to Tiverton, who had been instructed in France to teach others how to reel, and these cocoons were reeled there on the patent plan into 3,500 lbs. of fifteen-cocoon raw silk by this the only English filature ever set up, and which was made into excellent lace at Tiverton. Though there is no absolute difficulty in reeling good silk in England, it is not likely that, from the adverse climate, it can ever be grown here to commercial profit. The use of this size of raw silk for making lace was confined during twenty years to Mr. Heathcoat. At last Mr. Wild, at the instance of Mr. Dunnicliffe, ventured on a *part* of a bale. Since then a very large yearly consumption has taken place in Nottingham. Its use led Mr. Heathcoat to make chemical experiments in dressing silk net, which have resulted in his finishing it to equal perfection with the French.

The next patents taken out by Heathcoat in 1825 were Nos. 5103 and 5144, both being for divers methods devised for ornamenting or figuring lace, by applying 'pearl' in various ways upon its lace so as to form bouquets, flowers, &c.—intended as an approach to the 'applique' work upon hand made lace. A purpose which it answered in some measure until further improvements took place.

In 1831, No. 6173 was taken out for improvements consisting of appendages to ordinary bobbin net machinery, so as to produce a combination of various fabrics hitherto produced by the warp frame.

This is a very curious introduction of the stocking loop by the use of the warp needles and guides placed in connection and working with the twist lace frame. The method by which the two classes of instruments for twisting and looping are made to co-operate, would require the aid of the entire specifications and drawings to explain. The invention is one of great ingenuity. Probably the combined result of the two principles was to complicate the machine, increase its cost, and render it more delicate in work, without producing a result equal to these drawbacks.

No. 6222 was taken out in 1832, for further methods

for working devices ornamenting lace net. These plans were all valuable as aids to the consumption of lace fancy goods, pending their more exact and elaborate production on the machines. By a modification he patented in 1833, No. 6471, the sewing or connecting threads in breadths are inserted so as to lay hold of two bobbin threads. He also describes the mode for inserting threads on lace by taking hold of two bobbin threads at the top of the meshes and passing across the warp threads, forming a kind of cloth work filling or ornament.

Perhaps one of the most original and clever adaptations of the bobbin net machine is that patented by Heathcoat in 1835, No. 6967, for weaving tapes, ribbons, edgings, &c. in less space and with greater despatch than on the old weaving loom.

This is done by weaving in a transverse direction, *i.e* at right angles to the ends from the back and front of the machine. The ribbons, &c. stand edgewise side by side, face parallel to each other, and to the ends of the machine. The shuttles and bobbins furnished with weft threads governed by springs pass from back to front and *vice versâ*. There is a set of warp threads for each ribbon passing through headles; slaies clear the way for them. The ribbons as woven pass flat, side by side on the work roller. The warp gives off as the work beam thickens under regulation. Ornamented or fancy fabrics may be made by using separate warp rollers, and so different thicknesses of fabrics and tightness of warp threads may be provided for.

In 1831 Mr. Heathcoat became acquainted with the late John Handley, Esq., M.P., well known as devoted to the strenuous endeavours for improvements in agriculture.

The result of their united investigations into the important and difficult question of cultivating land by the application of steam power, was the construction by Mr. Heathcoat of a 'steam plough,' which he patented in 1832, No. 6267, under the description of "certain new or improved methods of draining and cultivating land, and new and improved machinery and apparatus applicable thereto, and which may be applied to divers other useful purposes." This machinery to be worked by inanimate motive power, (which, it was Mr. Heathcoat's conviction, would one day do most of the drudgery of life), he deemed to be a useful and profitable substitute

for animal power in many cases where ploughing, draining, &c. by traction, from the nature and form of the surface is difficult or even impossible.

The machinery consisted of a carriage with steam engine placed on it, and an auxiliary apparatus capable of supporting an extended rope chain or band at a distance from the carriage. The latter received progressive and retrograde motion from the engine, which also drew the ploughs and other implements to and fro between the principal and auxiliary carriages at right angles, or any other convenient angle to the line of progress of the principal carriage.

The wheels of this carriage conduct a broad, endless, flexible floor railroad or way, upon which the carriage travels, and will thus pass great weights over soft, swampy, and unstable ground. But on solid ground the carriage may be placed on rollers or drums instead of the endless floor. Other wheels are substituted for the carriage, proper for travelling on land or soil, firm and compact; so simplifying the machinery and apparatus.

Auxiliary carriages are placed on each side of the principal carriage, by means of which, through bands from thence passing round the pulley or barrel of the auxiliary carriage, ploughs and other implements are dragged to and fro between them at convenient angles, and so a wide extent of land is brought under the operations of the machinery and apparatus. Flexible floors or ways are also placed under the wheels of the auxiliary apparatus, varying according to the nature of the soil. The boiler and engine on the platform of the principal carriage gives it locomotion in a longitudinal direction, as well as drives the drums or barrels which work the track ropes of the ploughs, &c. to and fro.

This steam plough, though since superseded by those of Fowler and others, was considered the best that had up to that time been invented. Mr. Heathcoat was led principally to incur the labour and expence attending this invention, by his desire to contribute to the agricultural improvement of Ireland—an object he had in various ways sought to promote during the previous ten years. This steam machinery he considered to be specially adapted to the marshy unreclaimed land of the sister island.

The attention of many had been directed by political discussions to the social, and, as a necessary consequence, to the agricultural condition of Ireland. Mr. Heathcoat deeply sympathised with the sufferings of the peasantry of that unhappy country; and was led to join in the formation, in 1825, of the Irish Land Improvement Association, in the hope that it might effect important ameliorations there, beneficial both to

the farmer and labourer. His thoughts were turned to the question, whether the mulberry could be grown and silk produced there, and he sent 100,000 plants and a large quantity of mulberry seed to be sown, as a contribution at his own expence, and for an experiment. He had however stipulated in the projected laws of the company, that the shares should under no pretext be made the subject of sale and purchase upon the Stock Exchange; therefore, on finding that important rule set aside in the speculations of 1825, he at once withdrew, publicly assigning his reason for it, and the crash of 1826 amply justified his determination. Forty subsequent years of observation on the course of Stock Exchange proceedings, compel one to dread that it may become at last the most ruinous as it is the greatest gambling-house in Europe.

In 1837 a patent, No. 7359, was for a mode of ornamenting gauze, muslin, or net, cloths, stuffs, or any woven textures, and for tools and apparatus used in producing such ornamented work.

This was a mode of adding figures to the surface of the tissue to be composed of edgings, &c., by adhesion from using size, pressing the net and flowered work through rollers, and thus causing the super-imposed ornaments to adhere. Articles thus flowered had a sale for some time; but the method has not continued in extensive operation.

John Heathcoat and Ambrose Brewin his son-in-law and partner, patented in 1843, No. 9646, a new method of intercepting warp threads, so making the application of the Jacquard apparatus more easy and secure. It included also a method of producing longitudinal stripes in nets of various widths of cloth work, almost non-elastic, by using extra guide bars, and causing the point bars to take up more frequently. And finally, for ornamental printing on nets, which had been thickened by laying in extra threads. After this epoch, Mr. Heathcoat retired from the more pressing pursuits of business in his manufactory, and from endeavours after further discoveries in machinery.

This comparative leisure, when at Tiverton, led

Mr. Heathcoat to consider how he might assist in improving the education of the population there. As the result, a noble and well-arranged building was erected in a convenient situation at Tiverton for British schools. The edifice is of stone from a neighbouring quarry, shewn by this experiment to be capable of superior finish. The ornamental parts are of Bath stone. The iron work was cast in his adjacent foundry. One of the lofty and spacious wings is for boys, the other for girls; the central apartment is for the infant-school. These were opened publicly on the first of January, 1843, in the presence of the mayor and other principal friends of education in the borough.

In his remarks made upon this occasion, Mr. Heathcoat explained the motives by which he had been actuated, and the objects he had in view in establishing these schools. The observations then made, bring into view some of the characteristics of the speaker; especially exemplifying his firm, yet conciliatory manner in handling subjects, difficult in principle or practice. An abridgement of them will therefore be interesting to those who desire to form a correct estimate of the man. The subject was introduced by his saying, that:

"Happily there is now no justification necessary for such educational institutions. That question is set at rest. But doubts are entertained, as to the step I have taken in opening these schools, on the liberal principle of seeking to educate the children of parents of *all* denominations of Christians. I would cast no reflection upon those who differ from me in opinion; but claim the credit of good intentions, while exercising the right of acting upon my own.

"Similar schools have been carried on for the past half century, without injury or inconvenience; on the contrary with most satisfactory results. Allowing children thus to mingle together irrespective of religious distinctions tends to prevent those distinctions from rising up as barriers in after life, and encourage abiding kindliness of feeling. These being my honest and sincere opinions I desire to act upon them. I have not previously assembled you for consultation, because I did not wish you to put your hands in your pockets. I believed you would have confidence in my intentions: these I will honestly and impartially carry out.

"Great importance is justly attached to the selection of teachers. I have not thought it right in applying to the British and Foreign training schools to stipulate for more than that they should supply us with good and pious Christians; such as shall be well fitted for the duties they undertake. As in that establishment I found churchmen and dissenters living together in harmony and good will and with

no instance of a teacher being drawn over to other religious views; there is security for us, that the same results will take place here; and that the teachers will feel it their duty to instruct in the fundamental principles in which all agree, and leave alone those minute and difficult points of distinction, of which were we ourselves to think less it would be better. We too often look with microscopic eye for these points of difference, rather than for those on which we can agree, and having found them, magnify them into importance, and allow them to produce feelings most undesirable amongst Christians. I should be sorry if my friends of the church (of England) should think this a dissenting school; or erected in opposition to one belonging to them. Could the whole have been united in one large establishment, there would have been peculiar advantages, and I should have been much more gratified. I hope that because I have thought it my duty to provide this school for those who could not be benefitted by the other, no jealousy will arise between them; and that all concerned in this will cherish the kindliest feelings towards the national school and all others.

"The instruction to be given here must of necessity be elementary; but that sound and good of its kind, such as may be carried on if opportunity offers, with advantage by the individuals themselves in after life. Amongst the things to be taught, the principles of religion are of the first importance. It is essential that these should be inculcated even from infancy. For instruction in distinctive creeds, Sunday Schools offer the fittest opportunity; and we make it a condition that children admitted here must belong to some Sunday School.

"Another important part of education attended to here, is the formation of good habits—habits of cleanliness, order, subordination, industry and proper behaviour to equals and superiors; not by lessons or precepts only, but by training the children to practise them. Though for the present I and Mr. Brewin, purpose retaining the responsibility, we shall listen to any friendly suggestions with deference, and endeavour to act upon them. If however superior advantages were sought by any one on behalf of his particular party, we should not be prepared to meet his views.

"To those parents who may be desirous of sending their children to these schools, I may be permitted to address a few words as to what will be expected from them. We shall require that the children be fit to associate with other children. If from having had bad examples as to language and general habits, they would expose the children of others to danger and mischief, we shall be obliged to say to the parents of such, 'we fear the harm your children will do to others will be greater than the good we can do to yours, and we cannot admit them.' We do therefore expect and require from parents that they will take care by good example and as to health, morals and general condition, that their children shall not be rejected for the faults of their parents.

"I would say to the young persons who undertake the conduct of these schools, that the responsibility devolves upon them, whether the children are benefitted to the degree they ought or not. I rely upon them for the fulfilment of their duties in an exemplary manner; and to act with a wise caution amongst strangers and in meeting inevitable

embarrassments, as well as in forming new associations. Their active pursuit of duty will render them independent of companions and of the idle gossip resorted to by some to kill time. Being amongst strangers and without acquaintances, I wish them to consider they have one resource; and that is, any advice they may deem it proper to ask will be given most cheerfully by me. Towards the children they have already learnt their duty, and are more capable of teaching me than I them. Let them earnestly aim at combining kindness of manner with great firmness, though justly to unite the two is a difficult acquirement, and they will succeed. From all Christians here I am sure they will receive kind attention; from ourselves, every comfort and assistance."

These schools were not confined to the children of persons connected with the factory, but open to all; and have been continued in successful operation on this principle ever since.

When the lace machinery was brought to Tiverton in 1816, the ancient woollen manufacture was so wretchedly depressed, that the labouring population was little employed and worse paid. The town had become the residence of military and naval officers on half-pay since the peace of 1815, who no doubt chose it because of its mild climate and cheap provisions, perhaps also for the advantage of an ancient endowed school. The advent of such an addition to the population as that employed by this factory, gradually raised the prices of everything to the annoyance of some; but the compensative result to retail trade was very remarkable. An officer came there to reside, and remarked in the hearing of an old and experienced collector of King's taxes, that "the coming thither of lace machinery had ruined Tiverton." On which the other rejoined, "I can shew by my books, that in 1816 there were not three shop-keepers in High street," (the principal street), "who could pay their taxes regularly, and that now (1826) there are not three that owe any." Its old importance as a borough returned with the arrival of Heathcoat, and has remained ever since.

In the factory at Tiverton there were employed in 1836 about 1200 hands, in 1860 about 2000. On the occasion of an excursion to Teignmouth, in 1836, given to the hands and their families by the firm, 2300 persons formed the party. The operations carried on by these workpeople are yarn doubling, silk spinning,

making net lace, bleaching, dyeing, preparing it for the market, smithing, and frame constructing; together with those of an iron foundry and the manufacture of plough shares, coulters, horseshoes, and other farmer's implements, forming a useful establishment to which the neighbouring occupiers of land can have recourse. The gas for lighting the town has been from the first supplied from these works. Since 1828 the factory gates have been regularly opened and closed so as to secure ten and a half hours' daily labour, and give one and a half hours for meals. In 1860 the number of machines had been reduced to 150, but increased to 122 inches in width and of great speed. They were entirely employed in making silk net. As Mr. Heathcoat always finished the larger part and latterly the whole of his production, he had no motive to destroy his narrow machines until they were fairly worn out. Therefore he only begun to replace his old 8, 10, and 12-quarter by wider machines within the last few years, while at Nottingham the cost of new 16-quarter and 20-quarter machines had been of an enormous amount.

Mr. Heathcoat felt deep interest in the lace trade of Nottingham; and when it has suffered reverses, they have never failed to call forth strong expressions of his sympathy. The large amount received collectively for tribute up to the expiration of the patent, was naturally unpalatable, and left a feeling of displacency on the minds of some long after that time. In justice to him it must *now* be stated, that during the whole of the period that intervened between 1826 and his death, the writer of this work (for the larger part of the time the representative of his private business in the Nottingham trade) was entrusted by him to act unreservedly on his behalf in the public discussion and management of its affairs; and was empowered to pledge his co-operation to whatever the owners of the majority of machines should decide to be done, in pursuance of the general prosperity of any and every department of it, whether employers or employed. Such resolutions were without exception or hesitation carried into full effect, both in his own factory at Tiverton, and by his brother, Mr. Thomas Heathcoat at the Rawleigh Mills, at Barnstaple.

Thus when the trade reduced the working hours for twelve months from twenty to twelve, he holding at the time large orders and small stock, at once reduced his time to twelve hours; but when at the end of that year the Nottingham trade returned to twenty, he continued ever afterwards to work only the twelve natural hours of a day's labour.

The inhabitants of Tiverton, in 1843, determined to mark their sense of the liberal and benevolent conduct of their enlightened member, Mr. Heathcoat, by presenting his picture to the corporation of the town. The subscription for the purpose was more than sufficient, and a gold snuff-box was purchased with the overplus, which was presented to the honourable member at a public dinner, Lord Palmerston being amongst the guests. The likeness is an admirable one. In replying to the address of the presiding clergyman, Mr. Heathcoat made the following remarks:

"My friend, the president, has stated various reasons which have induced you to shew me this act of kindness, and I may say affection; but there is only one ground on which I can presume to accept this token of regard. It is not on the ground of merit of any degree on my part, but of kindness on yours. The reverend president has reminded you of the period when, I think twenty-seven years since, I first came amongst you. It will be in the recollection of many whom I see here that I came almost like a shipwrecked mariner cast away upon your shores. From that day to the present I have only experienced one series of kindnesses from you and of happiness among you. I am not aware that I have ever done any thing to merit this kind compliment. To contribute to the comfort of the town one lives in, is but securing one's own, and to attribute merit to a man for so doing would be almost as inconsistent as to be surprised at his endeavouring to make his own house comfortable. Our happiness depends as much on the comfort of our neighbour as on our own. No individual can be happy unless his neighbour be happy with him. There is one word that I am desirous of addressing to you, which I hope may be of service to others when I myself may be no longer useful to you. It is well known to you all that I entered life in that state which is not generally looked upon with envy, as an artizan who had to earn my own livelihood. Under these circumstances I had to encounter many difficulties. These have been overcome; and notwithstanding the situation in which I commenced life, I have had the gratification of receiving this testimony of respect, which I esteem more than everything else I have acquired. This will be an encouragement to others not to allow difficulties however formidable to cause them to despair. With industry and care, with perseverance, and above all with a strict regard to their duty to God and their neighbour, they never ought to despair."

Young men setting out in life always engaged his sympathy and advice, and he gave them encouragement derived from his own success. If necessary assistance, pecuniary and otherwise, was added, sometimes to an important extent. From his naturally cheerful and buoyant disposition, he took a bright view of the characteristics and talents as well as conduct of those around him, and in whom he took an interest. He was liable to be disappointed, and indeed was so occasionally; but this did not embitter his feelings or disturb his equanimity. He took a broad estimate of the importance of the things that make up the business of life; and the soundness of his judgment prompting to successful action in weighty trade matters, more than counterbalanced any mistakes in his estimate of individuals. Few men have won those by whom they have surrounded themselves more entirely to their interests and persons than himself; they repaid his confidence with a sincere and lasting attachment. About twenty years ago his managers, clerks, and agents presented to him a service of plate, as an expression of their grateful respect and esteem. The general body of his workpeople, to the number of between 1200 and 1300, presented to him in May, 1859, a silver inkstand and gold pen, on the occasion of his retiring from Parliamentary life. Without ostentation or display, and in the quietest way imaginable, Mr. Heathcoat overcame the local coolness with which he was met for a short time by some who disliked his eminent position as a great employer of labour, and feared his influence. This all gradually passed away, and was replaced by respectful esteem and confidence. It was no wonder therefore that upon the passing of the Reform Bill in 1832, when the ancient family influences in politics were disturbed by an increase of the popular element in the constituency, attention was at once turned towards him as a suitable representative for the borough. Such a public benefactor it was felt ought to sit in the supreme legislative body. He was accordingly chosen to be a member of that honourable house, just twenty years after he ceased to handle the hammer and the file, and continued to sit in it without interruption for twenty-eight years. During the principal part of that time, Lord Palmerston

was his colleague and his frequent guest. On several public occasions his lordship expressed his high regard for him; and when Mr. Heathcoat retired, from age and infirmities, took occasion upon his own re-election, to express his regret for the loss of so excellent a coadjutor, paying him an eloquent tribute of praise. Though Mr. Heathcoat seldom spoke in debate, he was indefatigable in attendance, and his aid in committees was much and deservedly prized. In politics he was not a theorist, but a thoroughly practical man. He would advance where it was safe and necessary, and would alter, expunge, or supplement where requisite; always, however, in accordance with the principles of the constitution. He made light of speculative theories in philosophy and science, and abhorred them in politics and social life; regarding them as alike delusive and dangerous. He was an every day and home reformer, and desired that each man who really cared for and governed his own family well, should have a voice in the government of his country. He knew by his own experience how vast a number might by virtuous self-denying efforts even now raise themselves into that position. Mr. Heathcoat's course in the House of Commons was equally patriotic and independent, free from faction and self-seeking; consistent and honourable, entitling him to that respect and confidence which he received from the best men of all parties in that assembly. It was his happiness to be joined in public life by similar self-raised men. At a dinner party in the house of a friend at Leicester, in 1834, there met Wynn Ellis, M.P. for that borough, Richard Potter, M.P. for Wigan, Joseph Brotherton, M.P. for Salford, William Biggs, M.P. for Newport, John Heathcoat, M.P. for Tiverton, and Richard Harris, future M.P. for Leicester. It was a re-union of remarkable men, placed in a position made possible for the first time; legislators drawn from a new class; who by the experience they had gained, the knowledge they would impart, and the influence they could exercise, must prove eminently useful in any deliberative body.

The business of the Tiverton lace manufactory is carried on by Mr. Heathcoat's only male descendant,

Mr. Heathcoat Amory, in partnership with others allied to the family.

Mr. Heathcoat was a magistrate and deputy lieutenant of the county of Devon. His unremitting attention to parliamentary duties, prevented his taking part except occasionally in the business of this borough and the district around. After two years of gradually declining strength, his useful and honourable life was brought to its close in January, 1861.

The following testimony was borne by a local Journal to his character in describing his public burial:

"The last earthly honours were paid on Thursday last to the remains of that kind and benevolent gentleman who has just gone from among us. A man who had rendered himself so truly illustrious by his philanthropy and virtue, by the disinterestedness and uprightness of his conduct, by his love of truth, and by his ardent attachment to the great interests of mankind, very naturally endeared himself to those amongst whom he lived; and produced an unanimous demonstration of respect, when his body was conveyed to the family vault in the churchyard of St. Peter at Tiverton, from Bolham House, his late residence. It was preceded by the Masters of the Ancient Blundell's Public School, and the Baptist, Independent and Wesleyan Ministers; also by the Borough Magistrates, the Mayor and the Town Council; and followed by a body of Clergymen of the Church of England, relatives, friends, his late fellow member Mr. Denman, the neighbouring gentry, the clerks, foremen and artizans of his factory; the long procession being closed by a large number of Tiverton tradesmen. All business was suspended and the shops of the town were closed.

"After an impressive service, the grave closed over one well known through a long life for his steady devotion to the cause of truth and patriotism; and for public and private virtues, commending him to the respect of all parties. Tenderly alive to the duties that wealth imposed, the poor and needy he never sent empty away; while he humanely relieved the distresses and embarrassments of his neighbours. He maintained a high sense of moral obligation as proved by the discharge of duties laid upon him with impartiality and uprightness. His sober and rational equability of temper and conduct, shewn through life, is an example worthy of being held up to all, especially to such as are called upon to tread a path so perilous as his, in the commencement of life. His name will continue to be revered, wherever philanthropy, patriotism, and virtue, are held in estimation."

What Mr. Heathcoat *was not* may be studied and imitated by every artizan with great advantage, when contrasted with several of the biographical notices in these pages of other men of great mechanical genius, and engaged in the same arduous pursuit after success and fame. The testimony of all who knew him, whether

in early or later years, is very significant. There was no misspent time nor indulgence in youthful follies. He was not found amongst men of unsound character and principles, the bane of the working man's home, and of his prospects, independence, and usefulness in after life. From all such he kept aloof; yet ever shewed the most sincere regard for the well-being of the humblest working man and his household.

Much that Mr. Heathcoat *was*, will have been gathered from what he *did*, and the position he so early attained and so well filled. The high estimate of his character in Tiverton, and the value of his services to it, have been recorded in the eulogium pronounced as it were over his grave. His services to Nottingham may be stated in one sentence. His invention gave to it a trade, which within fifty years has mainly assisted to quadruple its population, giving employment year by year at fair wages to probably 150,000 workpeople, and for the past thirty years made an average annual addition of £4,000,000 sterling to the trade of the country. His great natural gifts, sound understanding, quick perception, and inventive genius, were plainly manifested in the work of his life. He stored his mind well by a diligent study of the thoughts of others, as recorded in the best literature of the past and present age; and there were few subjects of importance in natural or moral science on which he had not formed well considered opinions. His studies and memory were aided through life by a faculty, whether intuitive or acquired, it is hard to say, of dismissing from his thoughts and memory matters of a trifling and passing nature, leaving a proportionally clear remembrance of facts, arguments, and the grounds of judgment upon important subjects, of whatever nature they might be. His conversation was instructive and agreeable, though from indisposition to assume marked prominence, and a determination never to utter thoughts or opinions hastily formed, he was slow to engage in discussion, except in the familiar intercourse of friendship. He knew when to speak and how to be silent, without any tincture of pride or semblance of cold indifference. Great wealth and a higher station had little influence

on the manners and habits of Mr. Heathcoat. His tastes and enjoyments through life continued to be of the simplest kind. He was of so calm and equable a temperament, that through a long series of much personal intercourse, the author never saw him really angry, though there were times and circumstances under which such an expression of feeling would have been quite justifiable. His address, like his countenance, was remarkable for smiling amenity and gentlemanly courtesy. Thus it was to all. One of his workmen said to us long ago, "He has always a kind word for everybody." Miss Mitford writing to a friend thirty years ago said—"Mr. Heathcoat has just been here. How charming and simple a person—how perfect a gentleman! But a man of high inventive genius must be so." Integrity and uprightness of conduct and character were allied in him, to that delight in excellence which ever seems to be an attribute of real greatness and goodness. He was true to his friends, and determined if possible not to have any enemies; therefore was silent and placable under injuries. He freely assisted the afflicted, the weak, and the necessitous; and was most admired and beloved by those who knew him best. They cherish his memory, and revere him for those qualities of head and heart, which render his character so worthy of study and imitation.

CHAPTER XVIII.

THE SINGLE TIER LEVERS' BOBBIN NET MACHINE.

In the year 1813 another modification of the patent or 'Old Loughborough' machine was effected, realizing the idea Mr. Heathcoat originally entertained of placing all the carriages and bobbins in *one tier*. This of course required them to be made of only one half the thickness, and the combs in which they worked to correspond. The general construction of the machine had to be so ordered as to secure the necessary solidity and firmness of the frame-work in order to avoid vibration. Steadiness in its movements had to be combined with perfect accuracy in the finish of all its multitudinous parts. Such are, indeed, requisites in every kind of complicated machinery, especially lace frames, most of all a 'Levers' frame, as will be plain when its present construction and powers come to be described.

This new conformation of the bobbin net frame was due to Mr. John Levers, originally a frame smith and setter up, of Sutton-in-Ashfield. He removed to Nottingham, and extended his operations to the construction of point net and warp lace machinery. The specification of Heathcoat's machine having, as we have seen, become well known to the artizans of Nottingham, and the success of John Brown's traverse warp giving a great stimulus to similar efforts, hopes were indulged that they might be carried on without incurring the penalties of legal contravention. To this object Levers devoted (it is said, but without any evidence, conjointly with one Turton) his mechanical genius and skill. These proved to be very great, as was shewn by the extraordinary results. His labours were carried on in a garret at the top of a building situated in a yard on the northern side of the Derby Road; and so quietly

and secretly as not to be seen by any one, even of his own family. The carriages and bobbins, things which had presented so much difficulty to Mr. Heathcoat, with some of the other inside parts, had been made as thin as was requisite by a relative, Benjamin Thompson, an extraordinarily clever workman in metals, who will be afterwards further spoken of. He never was permitted to see the machine in progress, but was the first, except the constructor, to witness its completion. Levers had no son; but two brothers, and a nephew John. All worked afterwards with him, and the nephew always stated they saw the frame for the first time when it was ready to work. They found it to be eighteen inches in width, waiting for materials and prepared to start: which it did without difficulty. The entire isolation of the inventor during this process was a remarkable fact. Levers had expended his available means in the lengthened experiments and necessary expenditure incurred during the years 1812-13. The house of John Stevenson and Skipwith, carrying on a lace business in Nottingham, was induced to furnish the funds required for producing more machines; upon what terms is not now known. There were built by him for them another 18-inch, a 27-inch, a 36-inch, a 45-inch, and two 54-inch machines, Levers retaining the first 18-inch for experimenting upon. These were worked in a shop on their owner's premises in St. James's street. It is probable that the then existing patent rights on the one hand, and the profits daily realized by Levers and his patrons on the other, were the reasons why no patent was obtained to secure what was new in his method. For it seems to have been a prevailing notion amongst the mechanicians of the time, that a patent must be taken out for *all* the machine, and not (as this might have been) for any parts or combinations only which were really new. This single tier at first became known under the name of "Stevenson's frame;" but has been long and universally called the "*Levers*' single tier" machine. John Levers, the nephew, worked in the 45-inch. The well-known John Farmer worked about 1814 with another hand in one of the 54-inch, each taking five-hour shifts, the machine working twenty hours a day. The production

was four pieces of ten racks each weekly. The wages were 5*s.* a rack for some time, *i.e.* £10, or £5 each workman a week. There is no difficulty in understanding the origin of night-work in the lace manufacture, when such wages as these could be earned, and no doubt well afforded by the price of the article. After some time the workmen were reduced to 4*s.* 6*d.* a rack; but on an attempted reduction to 4*s.* they all turned out. This was a serious affair for the employers, as from the complexity of the hand movements required by the machine in its then comparatively crude state, none but highly skilled workmen could make net. Moreover, four of them, Levers, John Farmer, Dann, and Young, united to build a machine from memory, and completed one, which they jointly worked on their own account; but certainly not to advantage as compared with the amount of wages they had left behind them.

Some of the bobbins and all the carriages in these six machines were stamped out by B. Thompson. Heathcoat describes in his specification the process he adopted to get the sides of his bobbins perfectly flat and true. B. Thompson employed one very similar to it. Two half circles of very thin brass were placed within each bobbin fitting exactly the inside; they were put on an arbour passing through the centres, and were screwed together very tight, and heated until the arbour shewed a bluish tint; from which, on gradually cooling, the inside half circle plates were removed. The bobbins came out perfectly flat, and capable of turning without friction or accident in the carriages. This, in Levers' machines, where often thirty carriages and bobbins must safely work together edgewise within the space of an inch in width, is evidently a matter of first importance. B. Thompson, who was a frequent companion of J. Levers, and quite able to perform any such kind of work satisfactorily, no doubt supplied the springs also, in the tempering of which he was very adroit, as also the guides. His uncertain habits however seem to have rendered further aid necessary. Mr. Anthony Shepperley, then a watchmaker in Chapel Bar, and having workshops in Woodland Place, was employed

by Stevenson and Co. to make a part of the bobbins, turn the verges, put in the springs, and finish the carriages. The pieces being so short, John Farmer recollects a new set of larger bobbins and carriages were obtained from Shepperley, but they got from these only eleven instead of ten racks in the piece.

Having invented this new and admirable plan of constructing a lace machine, and succeeded in placing it and himself under the wing of those whose interest would be sure to promote its use, and which at that time they could do to an almost indefinite extent, this was Levers' great opportunity—prosperity and wealth lay before him, but he missed them. For what reasons, or under what circumstances the connection between Stevenson and Co. and Levers was dissolved, is not certainly known. After it ceased, he worked in an upper shop in the higher part of St. James's street. It was there, that in 1817, he altered his machines from the horizontal to an upright position, and built many of them yearly. As nothing is heard of pecuniary supplies from any external source, it is fair to conclude, that the means he employed were derived from profits resulting out of his late connection. The horizontal position of his first machines, along with some other peculiarities of construction, had no doubt been adopted in order that they might assume as unlike an appearance to the patent ones as possible. Those he now made upright were probably sold at once. If he worked any on his own account, those who knew him well, say, the produce would necessarily be sold as it came off the machines.

He is described by one who saw him almost daily for years about this time, and his testimony is confirmed by others who knew his habits and character, as having been a friendly, kind-hearted man, and a great politician; fond of company and music and song, being himself band-master of the local militia, in which also one of his brothers was a member. His domestic relations did not conduce to his comfort; his wife was not a helpmate, and unhappily for his progress and fame, he was himself a free-liver and irregular in his application to business. He sometimes worked day and

night if a mechanical idea or contrivance struck him, and would then quit all labour for days of enjoyment with chosen boon companions. He was then living in Elliott street, New Radford, next his shop, from whence, on some improvement in his fortunes, he migrated to a better house opposite. At this period, he was frequently heard to say, that the machine he had constructed was only in its infancy, because of the great facilities it afforded for alterations and improvements. The success consequent upon the exercise of his talents shewn in his machines actually at work, (which from his known want of steady application through self-indulgence had surprised many), shewed there was no reason now to doubt his capacity to mature and perfect his great discovery. He seems, however, to have attempted but little in that direction. He knew that by his skill he had helped to extend widely the manufacture of twist lace, and this appears to have satisfied him. By his invention, he was in reality greatly assisting to lay the foundation of the machine lace trade, the annual English transactions in which have at times amounted to £5,000,000, and of which the share arising from the adaptations of Levers' beautiful machine, has not been less than £3,000,000 a-year. By the exercise of self-command, energy, and even a moderate amount of ambition, Levers' advance to eminence and fortune was inevitably secure. But stimulants at the work-bench by day, and each evening the acknowledged supremacy amongst his brother mechanicians and politicians, stole away his incomings and energies together; so that he was not unfrequently without a sixpence, and had to borrow the money wherewith to purchase the next morning's supply of food for his family.

Levers entered after a time into an engagement with Messrs. James Fisher and Co., the particulars and duration of which are not known to us. He went to France in 1821. Mr. Ferguson, jun., says, but certainly without any real foundation in the facts of the case, "driven thither by Heathcoat's monopoly of the bobbin and carriage; Levers and his son and nephew (his brothers) being peaceful men, and more musicians

than lawyers. They went to Rouen, where they set up their machines, by the aid and on account of the late M. Le Forte." He seems to have taken up his abode finally in that city; paying only occasional visits to Nottingham. It is confidently stated by his relatives that he died there (and not in Nottingham, as stated by G. Henson), in what year or in what circumstances we cannot ascertain. The almost entire forgetfulness in which his memory is now enveloped, is suggestive of mournful reflections in regard to the last days of one so highly endowed with talents, and so deficient in the self-government, necessary to a wise and profitable improvement of them.

Levers seems to have trained his brothers to the construction, setting up, and management of lace machinery. They remained in France, and it is believed in Nottingham that they died there.

John Levers, his nephew, was the son of Joseph, a machine-smith, at one time in Fisher's service. The father brought up his son to his own business, and having, as before stated, worked in one of his uncle's newly-invented machines, he proceeded to make them too. This business, particularly after his uncle went to live in France, he seems to have pursued with considerable success; as at one time he believed himself to have gained £7000. Perhaps this might be an extreme estimate, founded on the supposed value of his interest in machinery—a very fatal mistake, nowhere more common than in the hosiery and lace trades, from the great prices paid for it when new. However, in 1821, when thirty-three years old, he remarked, upon finishing a new house, "I am worth just about thirty-three hundred pounds." "This sum," he is stated to have "embarked as his share of capital in a partnership, under the firm of Fisher and Levers. Trade soon after declining, stock and machinery lessened in value, so that in a few years his capital vanished, and his interest in that business ceased, by an unexpected dissolution in 1832, and he never really looked up after." While a partner there, he took a patent out, No. 5622, in 1828, to give machines on *circular comb* principle a rotary power action; and in the same year, No. 5741, to put Levers'

machines on with the like rotary power. Also in 1830, No. 5940, for a rolling locker to the Levers' machine. These three were the first of the long list of patents, in which Mr. Fisher had an original or acquired interest in connection with the lace trade.

Levers, jun., took out with Pedder in 1835, No. 6778, a patent for improvements on the *pusher* machine. He died at Nottingham in 1837, in poor and dependant circumstances. His brother Robert was a foreman for several years at Messrs. Fisher's factory till 1847. Since then, the name of Levers has disappeared from the English trade.

It seems that one of the family, who went to reside in France, and is called John Levers, jun., constructed a rotary self-acting Levers' machine, having two extra catch bars with hook pushers to divide the carriages and a plate bar with nicks cut in it by which the divided carriages were kept steady by the pushers. Bailey's plan let them slip. Louis Paul Le Forte obtained a patent for this plan in England in 1823, No. 6423.

The Levers' machine is by far the most delicate, its inner parts working in the smallest space, and requiring the most careful adjustment and finish of any amongst those bobbin net frames which are principally used. It is therefore, when prepared for fancy work, the most expensive in its construction. This will readily be understood by the following description of one offered for sale while we are writing: Besides the parts necessary to make the net, this machine, 153 inches wide 10-point, has 80 top bars, 400 bottom bars, 54 threading beams, and a Manchester Jacquard to enable it to produce silk ornamented laces. Thus constructed, it admits of such alterations of meshes, fine work, thick threading, and every kind of breadth patterns, particularly narrow ones, (all being of late years regulated and controlled by the Jacquard apparatus) that this class of machines cannot be too highly regarded for its usefulness.

Being now worked by power, Levers' machinery, though it has become very wide and ponderous, does not require proportionate physical labour. But it necessitates great skill and attention; and has, in consequence, ultimately given employment to the larger part of the most efficient workmen in the trade. The wages they

can earn are such as will maintain them in comfort, and enable them to bring up their families respectably; giving them a fair education, and preparing them for taking their part in the battle of life.

In constructing his machine Levers availed himself of all the essential parts of Heathcoat's machine. The bobbins and carriages are in shape nearly resembling those of the patent, though of half the thickness only and considerably larger in size. They perform the same functions; are held by catch bars, entering into the nebs of the carriages which are pushed through the warps by stump bars and fetchers. In the act of traversing, one half the carriages were placed in the front bar, and the other in the back bar; they were then shifted sideways (shogged) one gait, and were then all brought into *one line* (tier) *again*. This arrangement is the chief ground of difference between the patent and Levers' machines. But from it there results much difference in construction and consequent adaptation for producing different kinds of lace. These will appear from the special uses to which this great class of machines has been put, and the efforts to improve and add to its powers which have to be noticed with as much brevity as is consistent with justice to so important a branch of the trade.

Levers' machines are made as coarse as five-point and as fine as fifteen-point. A ten-point guage requires twenty warp threads to the inch to produce traversed net, *i.e.* when a full warp is wanted. In this there will be twenty bobbins and carriages in the inch single tier on the central comb bar. Besides these, in making fancy goods there will be thick threads moved greater or less distances sideways, according to the weight on each thick thread beam. Of these thick threads there may be forty or more in an inch. Where there is no net in the ground there will be no warp. The lace is produced in that case simply by the gaiting (shogging) movements from side to side of the thick threads, and the twisting movements of the bobbins and carriages to and fro as they pass through and around the thick threads. The machine will make eighty or a hundred of these backward and forward motions in a minute with their complement of relative movements, or about one inch in length of closely woven lace, the whole breadth of the machine, however wide, each minute. The guide bars are placed in the lower part of the body of the machine, and occupy in comparison with their number a very limited space; the warp and thick threads are passed through orifices pierced on their polished surfaces, and there may be fifty or five hundred of these bars, each guiding exactly to the right or left its complement of threads as governed by the cards of the Jacquard at the end of the frame. The bobbins and carriages are driven at the speed described through this maze of tight and, for the most part, very fine cotton twisted threads, or even still finer untwisted silk filaments in the spaces of one-tenth to one-twentieth of an inch, according to the guage, working side by side clear of each other and of the threads through which they pass; and which threads have all between each movement of the carriages been themselves moved one-tenth to one-twentieth of an inch, so as to vary the particular intervals through which

the carriages pass. Were that side movement in the least irregular, the threads would be cut down, and possibly the machine itself seriously injured.

The above description shews the necessity for perfect solidity of frame-work, steadiness of movements, precision in form, finish and adjustment of the wheels that give motion to these thousands each of combs, points, guides, pierced guide bars, carriages, and bobbins—including their very springs and nibs. These springs are seemingly trifling things, but are of major importance, and must be of proper temper, setting, and operation for the making of good lace. All these parts have to work in perfect harmony with and obedience to the Jacquard, which controls all the movements in the course of the pattern. These are too quick to be followed by an unpractised eye, and the quantity produced may be thus judged of. The machine, from the working of which the above description was taken, was 144 inches wide; and was making 144 one-inch black guipuire silk edgings. It had produced 2000 dozen yards in the week, selling at 2*s.* 9*d.* a dozen, or £275, which, if continued through a year, and allowing for discounts, stoppages, and holidays, would result in an annual return of £13,000 from one machine. The chief points in management of such machines in a factory are—seeing to the drafting patterns, perforating Jacquard cards, applying them to the requisite bars in the machines, and then superintending the production of the required quality and quantity of work. If to this be added the efficient control of workmen qualified to deal with such costly and delicate machinery, it will be seen that the responsibility devolved on these superior workmen is a serious one. The proprietor has to decide the prior question of what the pattern shall be, and afterwards the quantities of any one pattern which such rapid machines may be permitted to produce. To these last two points more and more importance must be attributed, in proportion as competition and fashion are developed in lace.

Many had failed in attempts to make breadths on the Levers' machine; at length, in 1823, John Bertie and Richard Biddle succeeded in doing this,—

By breaking out three combs and cutting out one half the comb in each side, having a whole comb and two half combs coming over them, in the act of traversing these combs and half combs were made to shog back, and thus left the piece divided. They were joined again by bringing up extra warp threads to interlap in the carriages in the instrument called a 'turn again.' This method, since improved, was used extensively.

In 1824 breadths were made by Jacob Woodhouse on the three carriage plan.

In 1827, Roe of Radford, Robinson and Widdowson of Basford, and Bertie, were still engaged in these Levers 'turn again' breadth improvements. This year a rotary Levers' traverse warp machine was constructed by William Barnes.

In 1829 a rotary motion Levers' frame was constructed by Bailey of Leicester, in which the carriages instead of being pushed to division in traversing are drawn back by hooks. This was first essayed by Bryant in making Brussels lace.

In February, 1831, William Sumner, of Hose in Leicestershire, took out a patent, No. 6070, for producing bullet hole open work on Levers' principle.

By which extra 'turn again' bars, pusher, comb, and point bars are made to shog and to perform the various movements of a non-traversing machine. The spring of the right-hand traverse carriage was made tight, the left-hand carriage opening slack.

This method once employed six hundred machines. A list of them was sent to Mr. James Fisher, who declined at first to pay the inventor an agreed sum for the assignment of the patent, but afterwards paid it. Sumner then required interest. During the delay, traverse laces were superseded by straight down Levers' goods, and the method is almost forgotten.

In 1834, Bertie and Gibbons patented, No. 6621, an apparatus applied to the Levers' frame for looping each alternate warp thread at the close of the hole to the bobbin thread making four distinct twisted pillars and two looped instead of traversed closings of the mesh.

This was effected by adding stumps fixed on levers, revolving in a comb bar and slaie, which levers, operated on by the pins of an organ barrel cylinder, and by pushing the warp threads sideways, prevented them from looping, leaving large holes, which could be made larger at pleasure by the alteration of the cylinder.

This looped net has been extensively made; and when controlled by the Jacquard cards, an elegant but inferior article is produced.

Another article, first made for Messrs. Frost, Nottingham, and called 'fender' net, from its being a mesh simply twisted like fenders or wire fire-guards, was made on Levers' frames, in 1829, by G. Fox, of Radford, and lay dormant for twenty years. Having but two sides twisted and four sides each formed of a single thread, it looks exceedingly light and airy, and when of silk stiffened, very brilliant. It will not bear washing. It has been brought into very extensive use during the last twenty years, under the name of Mechlin, both in cotton and silk net. In making the latter kind there are about three hundred machines at work. A twenty-quarter wide frame will produce so much of this silk net, as, when stretched and stiffened ready for sale, would cover two thousand square yards weekly, or twenty acres of ground annually. It is now chiefly made on the circular rotary machines.

In 1832, John Langham, of Leicester, obtained a patent, No. 6348, for a rotary arrangement of the Levers' point bars having common pushers. Bryant and Harvey produced straight down square net from 5-point Levers' frame for curtains, garden nets, &c. It is said to have been the first machine on which this class of lace goods was made.

In February, 1835, T. Allcock, of Worcester, took out a patent, No. 6764, for a new kind of Levers'—

> In which, catch bars and other parts for moving carriages are put on a camel or general carriage moving on trucks on a circular frame. On these trucks the catch bars ride on axles, and rise and fall on an inclined plane; the catch bars slipping, and not dropping, into the nebs of the carriages. The whole propelled by a fan segment.

S. Sansom, in 1836, made square net on Harvey's plan, but without any point bars. A similar method has been used at Calais, invented by M. Saillè, having extra laps at the close of the hole.

Blomer made Levers' Grecian net by extra bars and extra beams, which was superseded by blonde. This plan cost Mr. Thornton a large sum in perfecting it.

In 1837, R. White, of Bobber's Mill, took out under

Mr. Foote's auspices, No. 7473, for Levers' open work, by inserting thick stumps between warp threads to let two carriages pass between the warp threads instead of one. It was superseded by straight down nets.

In 1841, William Shepherd made Levers' tattings by shooting in thick threads in devices. There were double the number of points in each point bar, and the twist was taken up at each time of going through the threads; laying a foundation for making many excellent fancy articles. He went to Lisle.

Davis, of Nottingham, made tape edgings, spots, weavings, and other devices.

By breaking out main guides, and substituting extra guides soldered on iron plates, so that a number of bars might pass the guides, shogging each time the carriages went through the warps.

About 1840 many experiments were being made upon the Levers' machines. A square net was made by simply interlacing the bobbin and warp threads, as also an octagon hole blonde. Saillè, of Calais, thus made it, and Sansom readily imitated it. On the Jacquard being introduced, laces of any pattern were thus made by operating on the warp threads. A new era seemed to have begun. The pusher bars used in Levers' machines were taken off; the carriages were kept always in the same combs not traversing; the interlapping of threads being done by the warp alone. This mode became nearly universal in Levers' frames; but the work is inferior except for laces that do not require washing. Wire grounds are however made by another method in which warp and bobbin are so interlapped and twisted as to hold out in width and against any ordinary friction.

From this time also Levers' machines began to be worked by rotary power. Harvey, Bryant, Sansom, Preston, Langham, and others, were amongst those who took part in this great onward movement of the fancy trade. The improvement of the entire machine in speed and safety of working, followed putting it on to power. The carriages were secured from slipping off the angular hook pushers, thus avoiding smashes of carriages and combs.

Hitherto also power machines had the carriages, one propelling and drawing the others; about 1840, Samuel

Barton, of Sherwood, built a machine having carriages moving on circular combs in a single line and traversing by a double locker, saving the time of a long motion of two sets of carriages.

Amongst what may be termed the 'composite' machines, in which have been attempted a combination of two or more of the principal methods, one was patented by William Henson, of Chard, in 1832, No. 6354.

In this an upper set of carriages in single tier was propelled by rolling lockers. The lower set of double tier carriages traversed and worked in bolts, and were separated in the act of traversing by an edged plate coming up perpendicularly, acting as an under locker. The net was twisted and traversed by bent pins put in front and back, but were withdrawn and entered again at every third or traverse motion, the bent pins acting as guides. This machine was driven by rotary power. Henson proposed to make ten racks of 240 meshes each in length, in an hour. He made forty meshes in a minute, but never made a whole piece at that rate.

In 1839, Mr. Oliver, of Basford, constructed an apparatus for making figured open and linen work on a Levers' machine.

This was said to be effected by substituting two tiers of very large bobbins and carriages for the warp main beam, leaving each thread at liberty as to its tension, each large carriage and bobbin acting as a separate beam. These warp bobbin threads were said to be acted upon by stumps, which were moved by the Jacquard.

This was an attempt at a mechanical pillow for making patterned lace.

Heathcoat from the beginning had made every part of his machinery on his own premises. Not so any of the infringers in their first essays, though several of the most important soon did so. The success of the patent machinery at Loughborough, causing the increasing construction of bobbin net machines at Nottingham on Heathcoat's principles, was the signal for originating the twin handicrafts of the bobbin and carriage makers. For though at first they were carried on in conjunction, they soon became and still continue to a great extent separate occupations. Those who first undertook these manufactures as an independent business were generally watchmakers. Such was Mr. Anthony Shepperley, one of the first who added this to his regular business. His articles were of first class workmanship, and gained him a corresponding reputation and demand.

It has been already stated, that in none of the component parts of the twist lace machine are excellency of materials and a perfect finish of more importance than in these, which compose the circulating system of the machine. Therefore the fine touch, trained sight, and habit of exact manipulation possessed by watchmakers were the best qualifications for and passports to employment in these departments. Anthony Shepperley is here specially singled out, because from the recollections of his family several interesting facts have been obtained.

After finishing the Levers' bobbins and carriages for Stevenson and Co. as already mentioned, Shepperley preferred to engage in making those for the *straight bolt* machines first constructed by Mr. William Morley. But notwithstanding an improvement introduced by Mr. Shepperley, tending to counteract the great defect in the working of straight bolts, by the application of a lever to the carriages, regulating constantly the amount of thread given off the bobbins in that class of machines, the circular comb quickly superseded them. He then began to make that description of bobbins and carriages for Morley and many others. The *dishing* of bobbins for circulars, was first done in the Nottingham district, at the instance and under the instructions of Mr. Morley. This reduced them in thickness and weight, while less labour was involved in making and finishing them. Amongst his numerous hands, Shepperley employed several Germans. All, and amongst them his own son Mr. George Shepperley, Long Row, found the employment more profitable than that to which they had been brought up. For instance, Mr. George Tritchler, a German, one of these journeymen, left this shop with £4000 savings, on which his widow still subsists. Another overlooker, still living, an Englishman, left this occupation with a considerable sum, having to receive £60 or £80 at each settlement beyond the wages he had drawn. All were very highly paid, and many of the men were equally provident. But the greater part were not so. They dissipated the earnings of three or four days in riotous idleness and indulgence through the rest of the week. Songs, in celebration

as it were of this sort of saturnalia were composed, set to music, played by the band of the local militia in marching to and from parade, to which these jolly journeymen added their voices in a choral refrain—

"For we'll all go a bobbin and carriaging,
Oh yes! we will go—yes! we will *all* go,
We'll go *all together*, a bobbin and carriaging,
Hip, hip, hip, hip, hurrah!"

The more their employers were pressed for their work, the less work would many of the men do while the fever lasted. All were very highly paid, and the profits of the masters were great in proportion. During several years the demand was so great, that it could not be supplied; the news of such wonderful wages, independence, and jollity, spread like wild-fire; so that speedily, machine-smiths, lock-smiths, and black-smiths, together with every watch-maker who had a wandering or adventurous spirit within fifty or eighty miles, came together in the garret workshops, extemporised in every quarter of Nottingham. In the case of many of the machines then contracted for at fabulous prices, cash was paid down in whole or in part for them, and yet they never could be made to work, or only after more still was spent upon them than they were worth when done. So in regard to bobbins and carriages, orders were given for unnumbered sets, and thirty or fifty pounds paid in advance, without any guarantee or even enquiry as to whether the recipients of the money understood, or *had ever seen a bobbin net machine at work in their lives.* There were well authenticated instances, in which such consummate assurance on the one hand, and infatuation on the other, were found to be literally true. No wonder then, that such inferior articles were made by inexperienced pretenders to the art, that if the other parts of machines constructed after the expiration of Heathcoat's patent in 1823, were made so as to do their duty, the sets of bobbins and carriages were often unworkable. So much was this the case, that to get an order taken by the really competent and honest maker, bank notes would be laid with the order on the desk, as an inducement to execute it. All the good makers reaped a

great harvest in those three or four years of excitement. Since then the business has settled down into a moderate rate of wages and ordinary profits. Messrs. Thornton and Aulton became large and excellent makers of Levers' bobbins and carriages, deriving like Mr. Shepperley and his successor, considerable and well-earned gains from the all-important fact that their articles might be relied on.

The following estimate was drawn up in 1836 from the information then and previously collected, as to the numbers employed in the various collateral branches of business in constructing machinery in the Nottingham trades in 1825 and 1835 respectively:—

	1825	1835
Master smiths . . .	80	30
Journeymen	400	150
Master bobbin and carriage makers	50	15
Journeymen	250	140
Smiths privately employed . .	300	100
Guide, pusher, bolt, comb, point, hook, and slaie makers	150	30
Needle makers, turners, casters, wood-work makers, setters up, &c.	270	55
Totals	1500	520

Each of Heathcoat's first bobbins (or wheels) containing the threads working diagonally, was pressed upon by a small tongue of steel placed on each side of the carriage, and acting as a spring to regulate the amount of thread given off in crossing and in twisting round the warp threads, Plate IX. fig. 2,—thus making the sides of the mesh and crossing, and consequently the shape and size of the entire meshes as regular as possible. Upon the attainment of this, in a great measure, the whole face of the article, as to its beauty and use, must depend. To equalize the force with which these springs act on the bobbins throughout their whole range, and along the length of each thread as it unwound itself, were great points to be attained; and even with these first inconveniently placed springs they were in good measure realized (Plate XIV., No. 15). But the process was difficult and tedious. The shape of the carriages was soon improved in all kinds of bobbin net machines; allowing a spring to be attached to the upper part of each (Plate IX. fig. 3), at the unattached end of which was


PLATE XIV.
11
12
13
14
15
A. GOATER, SC

a pointed nib, which just enters between the sides of the bobbins at their outer edges; and while it keeps them steady, regulates by its pressure on the periphery of the bobbin, the giving off of the thread. These springs are adjusted to each other by an easy process, but one requiring care. When filled with thread and placed in their carriages, these threads are taken into one hand, and the carriages and bobbins lifted up and slightly shaken. As the weight of thread in each is equal, those carriages in which the springs are too weak descend lower than the greater number, and those too strong do not fall low enough. Each are separately eliminated, and their springs are bent or straightened accordingly, till the whole set are equalized. To whom the invention of this valuable spring, now universally used, is due, is doubtful. It is said in a communication inserted some years since in one of the Nottingham newspapers—

"We believe the idea of fixing the spring on the edge of the bobbin was suggested by John Irving, but he could not execute it. After experimenting for twelve months at considerable expense, William Skelton, of Brick Lane, Nottingham, succeeded in perfecting the small nibs which enter between the sides of the bobbins, and thus enables them to hold double the quantity of thread, being made double the thickness, but occupying the same room. Such was the importance of this discovery that, to use the words of Mr. Heathcoat, now M.P. for Tiverton, 'the man that perfected and made that spring was the founder of the bobbin net trade, and not me,' as without it the pieces could not have been made of sufficient length to have established the manufacture."

As Henson makes this statement verbatim in his MS., and from internal evidence, there can be no doubt he wrote the article. G. Henson felt some prejudice against the patentee—on what account can only be surmised. He speaks of the 'Old Loughborough,' the patented machine "as merely an ill constructed, intricate combination of other men's inventions, too difficult and slow ever to work to profit, and nearly disused." The facts are all against this highly coloured statement, and as is in evidence by inspection of the sample of his net sworn to in 1813, given in Plate XIV., No. 15, it will be seen that more perfectly regular net cannot be made by any machinery now, than that which was made by

Heathcoat while using his first spring. Therefore the trade is not founded on the discovery of the new spring, though that is in many respects a great improvement. It is merely incredible that Heathcoat should ever have thus expressed himself in this matter. The article concludes by asserting "that had not Skelton produced the spring, there would have been no bobbin net produced." The writer knew or ought to have known that it had been produced years before, and of excellent quality.

William Skelton was originally a shoemaker, but early turned his attention to making the smaller implements used in hosiery and lace manufactures, and which required great care and precision in their finish. He appears to have understood and could explain well the intertwining of threads and formation of meshes in foreign laces; therefore was consulted as to the way to get out in machinery these difficult reticulations. Benjamin Thompson often stated however, in Skelton's hearing, that the spring and its nib were his (Thompson's) invention; as also that the mode of tempering it was his discovery; and Skelton on such occasions acquiesced in the claim. Thompson, it is asserted by his son, gave Skelton the plan, who being a clever workman, made them so well as to take and maintain the lead for their sale for a long time, during which it was his principal means of existence. The case may have been thus: Irving devised the spring only; Thompson tempered and gave it the nib, and, as they were companions, handed it to Skelton, whose position seems to have been a precarious one at that time. He was the first to apply the spring with two opposite nibs to the *pusher* carriages, and gained largely by them, others for a long while being unable to compete with him. He nevertheless died a few years ago in humble circumstances at Nottingham.

The name of Benjamin Thompson has occurred several times in previous pages, and we cannot pass on without giving some account of so singular a person; one, who during the first quarter of this century was universally known to the mechanical world in Nottingham, and not much less so to the men of

scientific note then resident in this district. He was born at Groby, in Leicestershire, and apprenticed to a chemist in London by a rich maternal uncle, who liberally supplied him with the needful resources. When out of his time he became acquainted with the elder Dolland, then in humble circumstances, afterwards the celebrated optician. From this intercourse he was enabled to make some considerable progress in the practical application of more than one of the natural sciences. He left London from some unexplained cause, thereby displeasing his uncle, and was cast off by him. He found his way to Nottingham, no doubt drawn thither by the then well-known skill of the machine-smiths and other artificers, who found good employment in the two staple trades of the place. He married the niece of Mr. John Levers, whose machine has been just described. Thompson's skill in handling tools, as well as making them, soon became noised abroad. We find him styled in various documents of those times, a brass turner, an optician, a maker of prismatic division lathes, and of various curious and useful instruments. From Dolland he acquired the knowledge how to make telescopes and microscopes. One of the latter of his make is now in use. Several of his turning-lathes are still doing their work perfectly, though made fifty years ago. It is stated, on good authority, that he could smelt, fuse, and purify his metals; turn in wood, iron, brass, and ivory; grind the object glasses, make the slides, put the parts together, and finish an optical instrument. He constructed a machine for slicing wood and plants for microscopic observations, dividing off some thousands of sections in an inch. A flute was required by the Prince Regent for presentation to another royal personage. The musical instrument maker to whom the order for it was given, confided its execution to Thompson, who went to London and completed it to his satisfaction.

With such an amount of useful knowledge and extraordinary handicraft skill, what might not Thompson have attained in such a time of mechanical effort and unlimited demand for the very class of objects he could best produce. He claimed to have made the *first* bobbin

and carriage for Whittaker. He certainly did so for Levers. Here was an opening to fortune, too plain to be mistaken. He could help his acquaintances (and they included every maker and setter-up of machinery of all kinds, large and small) to devise and construct it; but disdained to benefit himself, or to bargain with them.

He was employed successively on point net warp and bobbin net machinery, yet derived only a scanty income from them all, while others with less genius, stept on by paths open to everybody, to fortune and influence. Thompson was versatile, unstable, and self-indulgent; too independent of the ordinary laws that govern a really useful and happy life; too desultory in labour to be depended upon for its punctual performance however important; he solved the difficult problems which were daily cropping up at that time requiring apt skill and a sharp eye very cleverly, when he could be induced to undertake them, gaining the credit for them while others took the reward. He had great but misdirected talents, and his careless habits were manifestly inconsistent with the comforts of home and well-being of his family. He died poor at Nottingham, in the year 1825.

From the recent interference of the legislature in the employment of women and children in lace factories, the following explanation is necessary to shew what they do as to these bobbins and carriages, which have been likened to the shuttles in weaving looms, inasmuch as they supply weft to the bobbin net warp. The machines by their own operations gradually empty the bobbins of thread. The bobbins are charged with threads drawn from drums, on which the materials have been wound by boys from the wooden bobbins, which have been just before filled with the yarn from the hank by girls.

When these carriage bobbins, circular, flat, thin, and deeply grooved, are to be filled, the woman takes up as many as there are threads on the drum, and passes them by means of a square hole in the centre upon a revolving spoke or cylinder; stretching the threads over the bobbins, she slips each thread into

its corresponding groove. A few turns of a revolving machine going at great speed, fill the bobbins with a sufficient quantity of materials. The inferior qualities or errors in the size of cotton yarn or silk thread, shew themselves by the under or over filling of any of the bobbins. The bobbins when full enough are taken off the spoke, to be replaced by empty ones, over which the threads from the full ones are severally passed, and are then snipped asunder between the full and empty ones; the full ones are laid aside and the new set filled as before.

These full bobbins are next to be inserted, each into its thin steel-framed carriage, in order to its being carried with its thread to and fro, from back to front and contrariwise by the machine. This is performed by sharp-eyed young lads, with such rapidity and neatness of manipulation as looks very like legerdemain; the bobbin fixed, the carriage spring adjusted, and the thread passed outside through a minute hole in the carriage top. When the springs are evenly bent, as elsewhere described, the carriages with their contents are ready for the machine.

These young people, male and female, are now employed very properly only within factory ages and hours, instead of at hours in any part of the night, which was formerly the demoralising practice. As the sets of bobbins are necessarily emptied at uncertain times by the operation of making pieces, either there must be a double set of bobbins and carriages to each machine, or the workman must take his turn in obtaining a full one. This is a small cost at which to secure the great benefit now enjoyed.

CHAPTER XIX.

THE PUSHER BOBBIN NET MACHINE.

THE PUSHER machine was constructed first in 1812, by Samuel Clark and James Mart, assisted it is said by Joshua Roper, all of Nottingham. As contrasted with the patent machine of Heathcoat—

> The carriages containing the bobbins were pushed by long instruments through the warp threads; which bobbin threads were drawn off downwards and the net thus formed below was carried to a work beam also in the reversed position. The carriages were only held on short combs by the tension of the bobbin threads. An important difference exists between the double tier circular machine and the pusher. In the circular, *pairs* of bobbin threads with their carriages must necessarily act together; they cannot be parted in operation and effect. Whereas in the pusher, every bobbin and carriage being each operated upon by an independent pusher just as wanted, can be obliged to proceed in any direction desired, or remain at rest. Thus cloth work can be made more uniform and clear.

While this machine possesses some special advantages, it is costly and a delicate one in work. The pieces made on this plan are short, the bobbins not holding much thread. This was nevertheless a clever modification of the original machine.

Pusher cotton and silk nets with excellent fining clothwork are finished by needle embroidery passing thick threads around and through the finings and open work; so that cushion-made fancy goods, such as shawls, veils, berthas, &c., are closely imitated by articles obtained from this machine. In making the ground, fining, and open works on the machine for one such article, five thousand cards may be required. Mr. Vickers and Mr. Reckless have been and still continue eminent in Nottingham for their successful use of pusher grounds, as also for the superiority and execution of their designs. The pusher imitation of Chantilly lace

nearly approaches the real article. A *flat* appearance is all that serves to distinguish its mechanical origin.

In 1814, Clark and Leonard Elliott made breadths by extra pusher bars to let the carriages rest on the traverse motion, with extra beams to sew the threads. This net sold for double the price of wide plain net for several years.

In 1820, an improvement was made to the pusher by Joshua Crowder, John Day, and Richard Seymour, of Nottingham, and Francis Moore, of Radford—

> By adding a tie-bar to pusher-bars and making them act together. Thus instead of the pushers driving half of the carriages into the back combs and coming again for the other half thus making a blank motion, the half tier was taken to the back and returned and the other half taken and returned in like manner, which being thrice repeated reduced the motions from twenty-four to fourteen.

These persons sold their method to the trade, and received for it *promissory notes*, which were ordered by an injunction *not* to be circulated. After several years' litigation they obtained a verdict, but their attorney dying, they never received the value of their notes.

In 1821, Kirkland and Cooper moved point bars by wheels instead of treddles.

In 1823, a pusher circular machine was brought out by John Day, of Nottingham, and John Lindley, of Tottenham. Also Henry Mayfield introduced another mode of working it.

In 1825, Mart and Day constructed a circular pusher, in which the carriages were grooved and rode on short bolts to prevent their falling off. The plan did not succeed.

In 1828, the improved pusher machine was taken to Lisle by Clark, to Paris by Bonington, and to Calais by Rayner.

In 1829, John Synyer, Sneinton, by extra wheels and pusher bars, and letting the carriages rest at traverses, when single formed by it a *bullet hole;* when changed in the next hole, it formed *Grecian* net.

In 1830, Skevington, of Loughborough, by turning a spindle on cams, got increased speed and safety on the old patent Loughborough machine, and intended the plan to be applied to the pusher machine also.

James Pedder, of Radford, contrived, in 1832, an apparatus by which two sets of eccentric wheels moving at different speeds produced ornamented lace. In this method a thick gimping thread was placed by using long extra guides; spotting, by stumps pushing warps to prevent a traverse; linen cloth work, by breaking out certain main guides and inserting extra guides; net or other plain work, by cutting wheels suitable for each.

John Bell, Nottingham, made open works in required patterns on pusher machines in 1838. These might be different in each breadth if desired. He used an apparatus to answer to the draw-boy in the weaving loom. Also, in the same year, Day and Forgie applied the Jacquard and draw-boy to this frame. Forgie was a cloth weaver by trade.

He applied a long lever pusher to each carriage; but when open work was to be made, it was raised and missed the required carriage leaving a hole in the web; which once repeated and changed to the next carriage made Grecian net; if further repeated it produced a still larger mesh or open work; cloth work could not be made and the plan failed.

In 1839, James Wright, of Radford, applied cylinder Jacquard cards to pushers, adding them to Forgie's process in order to make cloth work ornaments. The carriages were traversed at every motion. This plan caused a large demand for black silk laces, since partly superseded by goods made upon Levers' Jacquard machines.

John Lindley, jun., resided in the first part of his business life at Loughborough, where he made point net lace. After assisting to improve that class of machines, he spent much of his time, from about the year 1798, in endeavours to produce twisted and traversed bobbin net. This he did at first, it is probable, alone; and is described as fastening his pocket comb in the slit of a table top, and using the teeth as points, from which to hang a series of cotton balls; and by his fingers twisted the threads, after the manner of the pillow workers. He thus made a small piece of irregular shaped net, two or three inches in width. This on being shewn to his uncle, C. Lacy, the latter declined to patronise it. If, as has been asserted, he knew and

had intercourse with Whittaker, who had not yet gone to Loughborough, it was most likely some years after this period. Blackner says, his next step was made in 1799, by the construction of a small set of bobbins worked on a singularly rude machine, on which was made a small portion of something like the present bobbin net; and at length this was followed in 1811-12 by another machine also entirely constructed by himself. This was upon the single tier arrangement which had been adopted and laid aside by Heathcoat, but successfully carried out eventually by John Levers, and known by his name. It made traversed net of twelve inches wide. There was one dividing bar (cut by T. Kerry) and guides (made by Rudd). Mr. James Fisher and Mr. Charles Lacy saw it, and they said they expected great results from it. The former took all the work made upon it in its rough state, giving £1 per lineal yard as its price.

Lindley's son, then a youth, wound the thread upon the bobbins in his play hours, and thus earned his first watch. Why the frame was thrown aside is not stated by his son, who furnished some of the foregoing particulars. The model of it was in Lindley's possession in 1828. Guides and carriages used in it were placed in the Nottingham Exhibition in 1840, but unfortunately the opinion of Mr. Sewell, who examined them, cannot now be obtained. The author did not see and therefore is unable to describe them. The invention by Levers and its extensive adoption, was probably the reason of this machine not having been continued in use. The circumstance of Lindley's endeavour to make lace before Heathcoat's patent, and his subsequent use of a bobbin and carriage, does not throw any light on the claim put forth for Lindley as the *inventor* of these important and ingeniously combined instruments; nor on Whittaker and Hood's proceedings; nor does it affect Heathcoat's claim to originality. They were all at work close to each other; but how far Lindley had then progressed is not now known. G. Henson gives 1809 as the date of the invention of this machine; on what ground does not appear. It is certain that the son, who states 1811-12, must have the best knowledge of the year,

for he says "the construction took place in the chamber in which I usually slept, but often could not, by reason of the inharmonious jangling of my father's operations."

John Lindley, afterwards being in connection with Charles Lacy (partner in Heathcoat's patent), took out a joint patent, September, 1816, No. 4063, for a machine in which were combined the peculiar systems of the Levers' and traverse warp machines, and to be worked by a *rotary power movement.* It was unhappily an unprofitable effort, and resulted in ruinous consequences to its projectors in regard to the business they were carrying on at Tottenham in Middlesex. The separate machines sought by them to be made of combined use, were found by the trade each to have its special adaptation and value. The expence of constructing the machines on this new plan was enormous at that time and at that distance from Nottingham, and it failed by this and the delicacy of its organisation to secure adequate results. Nevertheless it contained the bold idea of working the lace frame by rotary power action; and which, through some mechanical arrangement or other, has gradually been introduced into every department of bobbin net, warp, and even hosiery machinery. The direct result of this invention of Lindley's was disastrous to him; its indirect influence was highly beneficial to the lace trade.

In this machine the carriages were very long, and the bobbins were placed at one end of them, while the entire series of meshes across the machine was completed by six movements only. To describe, in a popular manner, the thousands of instruments employed, and the peculiarly diversified operations whereby they are made to co-operate, seems impossible. The plate given in the specification, shewing a front elevation of this machine, is a great curiosity. It may be called an outline portrait of mechanical genius; which, contrasted with the picture of Lindley making his first effort at *meshing* lace, by using his pocket comb and cotton balls, cannot fail to astonish these who doubt what a self-taught mind can accomplish; and will cause deep regret, that in this, as in so many other instances, such a severe course of mental labour, directed by

practical, though in this instance misdirected skill, should not have met with its commensurate reward.

Mr. Lacy embarked in this invention with the patent and machinery, the very large sum which he had realised under Heathcoat and Lacy's patent, and spoke of applying for an *Act of Parliament* to authorize secrecy of the methods employed under the patent, and so secure the expected benefits entirely to themselves. The idea was characteristic of the man. He was loud in his lamentation over the change which supervened in the position of their affairs; Lindley, a clever and of course greatly disappointed mechanician, knew how to carry his misfortunes with modesty into an unrepining retirement. An examination of the specification and drawings, describing how the more intricate parts of machines so widely different in construction, are made to work together in subjection to inanimate rotary power, will furnish ample evidence that Lindley very nearly attained a position in the first rank of our local inventors.

The art of *meshing* has been spoken of above as one in which Tarratt, Heathcoat, and Lindley engaged in connection with their efforts at mechanical lace construction. This is a science of no small importance, which has been investigated, and in some considerable degree acquired, by every one who has made any important advances in the manufacture of lace, whether in the construction of machinery, or its application and use in the production of almost endless varieties of ground-works and designs. It has been the study of lace patentees, from Morris in 1780, down to the present time. In the case of several of these, curious instances of its value and of their facility in its use, are on record.

It consists in a careful examination and study of the different classes of *pillow* lace; ascertaining the number of threads used, and their several courses, in the formation of every kind of mesh; the number and order of twists, plats, weavings, and crosses, which are formed with each pair of threads; the fine-works, open-works, thick threads, points, and pearls, which go to make up the texture of each class—Mechlin, Brussels, Alençon, Valenciennes, Lisle, Bucks, or Honiton.

This information is necessary to be gained, in order to be fully aware what is to be done by the machine, so that imitations, more or less perfect of any of these, may be obtained from it. And this, always taking into account that the mechanical progress of the work is not by dealing with merely single pairs of threads as on the pillow, but by forming thousands of twists, plats, or crosses at once, and, that there can be no actual retrogression, every movement is one in advance. A thread cannot return at all, though some may for the moment be held stationary; but each and all must proceed *onwards, if at all,* with the continued action of the machine; and the effect of this upon mesh and pattern must be calculated upon, and subordinated accordingly.

Persons who have applied themselves to this kind of investigation, so as to become familiar with its details, will follow out and master the intricate courses of these threads with surprising ease and accuracy. They get into the mind a full and clear idea of what they wish to accomplish, and thus can proceed to invent, adapt, or add to, a machine; having, by a peculiar mental process, carried on almost involuntarily, often in the dark, and not unfrequently in bed, seen their way to contrivances, modes of construction, and operations that lead, often it is true, by a round about way, to the desired result. It is thus that the *mesher* obtains an accurate knowledge of the thing to be produced; is enabled to devise means requisite for its production, and how he must apply them to the machine, so as to make them effective.

This habit of analysing the component parts of things to be produced, and the means best adapted for effecting them; of mechanical powers and their action, of separating and casting aside the superfluous, and securing the aid and effect of that alone which is necessary, has distinguished the crowd of acute, self-taught mechanics, who have within the last century, applied their talents to the staple trades of the three midland counties. Its incessant application has issued in the wonderful inventions and scarcely less surprising improvements now witnessed in its machinery. In the

search after speed, exactness of imitation of real lace, and variety of designs, they relieved themselves from obstructions unknowingly laid in their way, by the want of foresight or of mathematical skill on the part of the original inventors, or of those who from time to time have introduced changes in these mechanical operations.

There were no inherent advantages to be gained, by uniting the lever and traverse warp plans in one machine. They are each composed of very delicate instruments, working in most confined spaces, and in very different ways. In this attempt, Lindley therefore made a serious mistake. But in carrying it out, he much simplified the functions of each of these plans; so that motions of Heathcoat's original machine to which they owe their common origin were at length reduced in Lindley's machine to six. The reduction of working parts must have been equally great, for every motion requires a mechanical agent to effect it; take away the necessity for the motion, and the part requisite to its performance disappears.

The steam power, which Lindley was the first to apply, has been found to be a vital necessity; and in the processes of separately adapting the two kinds of machines above-named to rotary motion, they have been found capable of still further improvements. So long as these efforts were confined to the production of plain, *i.e.* unornamented nets, though of meshes of very different constructions, the skill of the mechanician was directed to dealing alike with the course of the threads composing the meshes forming the entire set from side to side of the machine, and was carried into effect by varying or simplifying its *ordinary* movements. It was by the practice of clearing needless parts away, which has been described, that room was made in which to place the additional instruments for making the almost perfect imitations of real lace, which the exigencies of the trade brought into use, as will be further indicated while describing the progress of the manufacture.

CHAPTER XX.

THE GASSING, BLEACHING, AND FINISHING OF LACE. MR. SAMUEL HALL.

The rapid developement of the hosiery and lace manufactures of the midland district had a corresponding effect upon the collateral operations of bleaching, dyeing, and finishing yarn and wrought goods. By the application of practical chemistry considerable advances were made, whereby fast bright dyes were imparted, and nearer approach secured towards French colours and finish. Thus the houses of Keely and Windley laid the basis for their well-earned success and property realized in that department. By the like spirit of research in the sister arts of bleaching and finishing, great improvements were effected; amongst others by the house of Robert Hall and Son—a name which has thus become identified in an especial manner with the staple manufactures of Nottingham.

Mr. Robert Hall, the father of Mr. Samuel Hall, lived at Basford, near Nottingham. In the early part of his life, passed during the latter portion of the last century, one of his businesses was that of spinning cotton yarn for hosiery purposes. Afterwards he spun a mixture of cotton and animal wool, into what is called angola yarn, a useful article extensively consumed for stockings, possessing a medium warmth between cotton and worsted hose. He was a scientific man, who if he did not discover, was one of the very first to use chloride of lime in bleaching, which was another department of his affairs. The benefit resulting from this improvement has necessarily been very great in the hosiery and lace manufactures, where cotton goods to the amount of several millions sterling per annum have been for the last forty years submitted to this

process; by it goods which would under the old plan have required to be retained a month in process, can now be well and soundly bleached in two days. This Mr. Robert Hall was an estimable man and a good citizen. His ideas on several subjects were peculiar and somewhat ahead of his age. By his love of scientific researches and experiments, he gave an impulse to the minds of two eminently gifted sons, Samuel and Marshall Hall. These received a liberal though not a profoundly learned education; and each, following out the natural bias of his mind, copying also their father's example of free and ardent enquiry, entered upon a diverse but remarkably useful career in life.

The younger son, Marshall, was born at Basford. Entering on the medical profession, he received a sound training in the general hospital at Nottingham, then practised for a time at that town, but soon transferred the exercise of his professional talents to London. There he became the celebrated Dr. Marshall Hall, to whose profound physiological researches are owing discoveries, especially that of the duplicate nervous systems, highly appreciated by medical authorities, and which have conferred lasting benefits on mankind.

The second son, Samuel, was also born at Basford. He was engaged from his youth with his father in the spinning and bleaching businesses, and also was early initiated into his chemical and mechanical investigations. There was a patent taken out by the father (it was his only one) in 1813, No. 3675, for machinery to be employed in dressing and finishing frame-work-knitted goods. Samuel Hall, when once embarked in these scientific discoveries, pursued them with unwearied diligence. Success never satisfied him, and disappointment never cooled his ardour; with a mind always on the utmost stretch of activity he gave up the pursuit after improvements only with his life.

His first effort was an eminently successful one, and also of an entirely practical character. All woven fabrics composed of threads of animal wool, cotton, or silk, however carefully spun, have on their surface more or less of rough hairs, floss, or fibre which are unsightly when lying on the surface of printed cloths or other

stuffs; but in gauzes, nets, or other fabrics intended to be semi-transparent, they are positively detrimental to their use. Mr. Samuel Hall must have often noticed this in the course of his business of spinner and bleacher, especially in the case of warp point net, and at length in twist cotton lace; to seek for a remedy would be therefore very likely on the part of so inquisitive a mind.

The floss on the surface of cotton cloths is usually singed off by passing the pieces with an uniform velocity over red hot cylinders of iron which burn off the loose fibres, the cloth proceeding too rapidly over them to permit of injury to it.

To remove this disqualification from cotton yarn and lace, so materially affecting their value, and consequently their use and the extension of their manufacture by machinery—the subject of this memoir devised and took out two patents, both of them under date November 3rd, 1817, Nos. 4177 and 4178, securing the use of a very ingenious apparatus and process, whereby in the former the fibre of thread, and by the latter of cloth or gauze, or lace, may be singed off by being caused to pass through delicate blue flames of carburetted hydrogen coal gas, drawn to the height of half an inch or so up to or through the web intended to be cleared, by means of a vacuum above. The processes by which cotton thread and woven tissues are gassed are substantially the same.

At Plate IX., fig. 8—

A represents gas flame issuing from a pipe through numerous orifices. *B* a row of threads or web of cloth or net drawn uniformly along with the requisite velocity to prevent its catching fire while passing through the flame. *C* the section of a kind of chimney, cap, or vessel, running the whole length of the horizontal tube, and terminating in the tube *D*; through the connection of which with an air pump of great power worked during the whole process, a brisk current of air is kept passing over the inflamed gas. The consequence is that the web to be cleared (gassed) from fibre presses rather forcibly against the bottom of *C* and the flame is cut off without passing through the web of cloth, but singes off the fibre only on the side exposed to it; if of lace or yarn the flame passes all round the threads and through the meshes, destroying the fibres on the surface, but without injury to the substance.

There is a second tube placed about a foot from the former in which are similar openings for gas to be emitted; through which also when lighted, the threads or web are to be passed by means of rollers,

and thus the process is completed. Stop cocks and valves are so placed as to regulate the emission of hydrogen gas, and the exhaustion of the covering above it.

This difficulty of cloudy, rough surfaces on nets and yarns, once thought insuperable, has thus been removed effectually by a very simple process, resulting from *a priori* reasoning on the principles of pneumatical chemistry applied to the special requirements of the case on hand.

In 1823, No. 4779, a further patent was taken out by Samuel Hall for improvements in the gassing frames. And its present adaptation is so accurate and complete, that though mainly entrusted to the hands of women and children, and in the case of thread, the yarn operated upon is to form exclusively warps for the finest and most delicate fabrics, which, if too much singed, would be made tender and worthless, yet the result is generally perfectly sound and satisfactory.

Up to this point in Mr. Hall's course of invention, he had the practical skill of Mr. Benjamin Thompson, (elsewhere more fully spoken of) at his command, to assist in carrying into the most perfect operation the novel suggestions of his own fertile brain. Hall devised the plan of gassing without doubt; it is equally certain that Thompson's knowledge and skill were employed on executive details.

Hall took an extraordinary method of making his invention known, by very widely exhibiting its actual results. He made an arrangement with a lace house in the Strand, and advertised under their name of G. F. Urling and Co., the patent *gassed* thread and lace, causing specimens of these articles themselves to be placed beneath the advertisement in each copy of several of the then popular magazines. Thus he was one of the first to introduce the system of advertising on a large scale, since so generally and successfully followed in regard to business matters. These notices served to spread more widely the knowledge of patent bobbin net and to increase its consumption.

When this patent was obtained in 1817 there were about 700 bobbin net machines at work; in 1820 there were 1008; the average of the first five years to 1822

was about 1000, of probably six-quarters in width, and making 200 racks weekly, taking three racks to the lineal yard. The charge for gassing lace was three farthings per square yard for some years. As nearly all the trade had their nets gassed, *i.e.* about 5,000,000 square yards a year, the amount of Mr. Hall's income from this source might then probably be from £10,000 to £15,000 a-year. The inducement to infringe became very great. Cyrus Boot, and others, did so under colour of patent rights for *singeing* by other processes, but they proved illegal and fell to the ground, after putting Mr. Hall to serious expense and otherwise causing injury to his interests.

As was to be expected, Mr. Heathcoat being the bobbin net patentee, held himself and by his connections machinery producing nearly half the total amount made; and as they gassed all they produced, had paid Mr. Hall during the first four years several thousands annually. On their part and on his own, the patentee offered to enter into an arrangement to pay £5000 a-year to Hall during the remaining term of his gassing patent, or for so long as he maintained the then price for gassing and kept down infringement, in compensation for the right to gas all the nets produced from their machinery then constructed. This was immediately declined. Mr. Heathcoat was sensible that he had been benefitted by the publicity Hall had given to bobbin net; though without the bobbin net invention Hall's would have had much less chance of success. Believing, therefore, that he was making a proposition calculated to be profitable to both parties, he declined to receive a refusal from Mr. Hall without the latter taking due time for consideration. The following morning Mr. Hall gave a final negative, on receiving which Mr. Heathcoat adopted the alternative of selling all his production without gassing the nets. This he continued to do for several years, and thereby no doubt reduced the quantity of nets sent by the rest of the trade to be gassed. Probably Mr. Hall never dreamt of such a resolution, or if he had would not deem it possible to be really carried out. By this mistake, arising from his over confidence and characteristic impetuosity, he sustained a very serious

diminution in the profits he would otherwise have realized by this patent. As it was, it could not be justly affirmed that he was an unrequited inventor. To this charge lately made it was no doubt truly replied that Mr. Hall gained at least £50,000 to £60,000 clear profit by this gassing patent. The increase of the trade and its machinery was so rapid that in 1826 there were 2469 bobbin net machines, and 4,500 at the expiration of Hall's patent in 1831. The superior character of lace and other fine fabrics when gassed was more and more recognized. Mr. Hall also gave numerous licenses to use his patent in Lancashire, Scotland, France, and elsewhere; so that altogether he realized a considerable income to its close. By this patent he established his position as a successful man of science in its application to manufactures. He had conferred a most important and lasting benefit upon the lace, muslin, and gauze departments of business.

In 1821 he took out a patent, No. 4559, for another successful discovery, also beneficial to local and some other important trades, and useful in domestic life. This was the bleaching of starch employing a chloride in its preparation, by which its quality and colour were so improved, as to give the substance thus treated precedence at that time and long after over any other starch used in the finishing of many kinds of goods for sale, and in getting up of linen and cotton articles in the laundry. In consequence, however, of the patentee engaging himself largely at that time, and, indeed, through all the rest of his protracted life in experiments and improvements (of the utility and value of which he never had the least doubt) on land and marine steam-engines, generation of a new motive power, and the consumption of fuel and smoke—he, with extraordinary indifference to ordinary prudential considerations, gave this lucrative patent into the hands, and to be used for the advantage of his third brother, Mr. Lawrence Hall, then lately returned from abroad; to whom it became the foundation of a large fortune. Ever since, and up to the present day, the public sees advertised "Lawrence Hall's Patent Starch." The name of the scientific inventor and munificent donor was thus ignored even while

he lived; and we are not enabled to record that when affluence vanished, and declining years supervened, any adequate return was made for so generous a gift. Mr. Samuel Hall seemed constrained by the very constitution of his being, to invent or perfect inventions without interruption, and at whatever cost. Except to supply means for the prosecution of these incessant self-imposed laborious experiments, he did not know the value of money. He could neither husband present resources, nor provide for the future. But of this, the too frequent defect of men of genius, he appeared to be unconscious. Thus his latter years were overshadowed by a sense of wrong shewn to himself. Mr. Hall was naturally of an ardent, sanguine, enterprising temperament; indefatigable, undaunted by failures, and undismayed by difficulties. He was kind, hospitable, and cheerful amongst his friends, shewing no hesitation in communicating all he thought or knew or felt to those, and they were many, who enjoyed his society. After forty years of personal intercourse and correspondence, we gladly pay our tribute of respect and admiration for talents and services of which Nottingham may well be proud. Mr. Hall died lately in London at an advanced age.

The following patents, combining an amount of ingenuity and usefulness seldom exhibited by any one individual, being foreign to the special subjects of this history, are enumerated without further details, simply as an act of justice to the memory of this prolific inventor and remarkable man:

In 1824 Mr. S. Hall took his first patent, No. 4985, for an inprovement on the steam engine. No. 5659, in 1828, was for an apparatus for generating steam and various other gases. No. 6204, in 1831, was for a steam piston and valve, lubrication of valves, condensing of steam, and supplying water to boilers. No. 6359, in 1833, for lubricating pistons, rods and valves; condensing steam by a vacuum and a mode of condensing for other purposes. No. 6556, in 1834, for a super-heating steam engine which if of twelve-horse power stands in only fifteen feet of cubic space. In this engine he augments oxydation by burning gas, and connects with it an apparatus for decomposing water; and proposes by this engine with no increase of cost in fuel to get nearly treble results in power. No. 7135, in 1836, steam engine for propelling vessels. No. 7754, in 1838, method of heating or evaporating fluids in generating steam. No. 8233, in 1839, method of propelling vessels. No. 8792, in 1841, and No. 9345, in 1842, were for improving consumption

of fuel and smoke. No. 10531, in 1845, improvements in boilers, furnaces, and flues of steam engines; in consumption of fuel and preventing smoke also in mode of propelling vessels. No. 12527, in 1849, apparatus for regulating combustion of fuel and burning the smoke; and prevention of explosion of steam boilers; by constantly passing fuel into the furnace on an endless revolving chain platform as it may be needed. No. 13444, in 1851, for manufacturing starch and gums. No. 14125, in 1852, for the improved construction of cocks, taps and valves.

Cotton lace, after going through the processes of the machine, has acquired a colour much darker than that natural to the wool: but bleaching restores the article to a perfect whiteness, by scouring and the use of bleaching liquid, &c. A piece is often returned soundly bleached within twenty-four hours after delivery; is forthwith dressed, finished, and received in London or Liverpool the next morning. Messrs. Manlove and Allcott, bleachers of Nottingham, patented a drying machine, by which, instead of being wrung or pressed and hung up in a hot room to dry, as is the usual mode, the article being wrapped round in a kind of coil between two copper cylinders, the outer one of which is perforated with holes, the apparatus is made to rotate perhaps a thousand times in a minute, so that by the centrifugal force thus obtained the water is quickly driven out from the damp article inclosed, through the holes of the cylinder, and left nearly dry. This valuable invention is already applied with very important results in manufactures greatly diversified the one from the other.

The dressing of lace, so as to fully extend the meshes to their proper shape, and by stiffening the fabric prevent its collapse, is a most important operation, and of course requires care and experience on the part of the class termed dressers, of whom there are about thirty-three having extensive premises in or near Nottingham.

It is performed, first, by passing the bleached or dyed and purified lace pieces through a hot mixture of gum and starch with other materials, and then submitting the lace to the action of revolving cylinders which squeeze out the surplus stiffening fluid: this is the work of a man and a boy usually. Second, the piece in a wet and heavy mass is taken to the stretching room which extends from forty to one hundred and

twenty yards in length, and is wide enough usually to allow of two frames being placed at a sufficient distance to be worked side by side. On the sides of the rooms as many large windows as possible are placed, chiefly for ventilation. The heat required is great, seldom under eighty degrees, it is often much more. These frames run nearly the length of the room. Upright rows of pins are placed along the edges, the selvages of the piece are run on by girls on each side and at the ends. The sides of the frame are made to recede from each other by the operation of a winch, and the lace is gradually extended to its full width; the utmost care being taken not to disturb the mesh either in length or width. On this point will absolutely depend the quality and saleable value of the article. Strict attention has also to be paid to the amount of dress in regard to stiffness and weight, if for single, double, treble, or even quadruple stiffness; and as to colour, clearness, crispness, and elasticity, on which particulars, together with the peculiar ingredients used, have depended the preference which was so long given to French over English dressing of plain silk nets. Third, to secure freedom from small blotches of stiffening and impurities clinging to the meshes, the pieces are lightly and carefully rubbed with flannels to equalize the stiffening and then beaten by switches or rods as they are distending; and to promote rapid drying and the consequent clean face and elasticity in hand of the dressed article, the piece when fully stretched is fanned with broad spade-like implements, which being properly waved about produce powerful currents of air. Fourth, while one piece is drying on one frame, another will be in process of putting on and stretching out on another. When finished each is carefully rolled up as it is stripped from the pins and folded preparatory to its being sent to the finishing warehouse; where, the selvages having been placed exactly even in rolling off the dressing frame, it will, if a wide plain piece, be cut up without unrolling, into suitable widths for sale.

The length of the daily employment of young women in these dressing rooms and its effect on their health, has lately been the subject of enquiry by a Government

Commissioner. The labour and heat are no doubt trying to those engaged; they are also usually careless of their own health and the means of preserving it when exposed to cold and wet in going to and from their work in our variable climate, having had but little domestic care or training bestowed upon them. It is possible, and much to be desired, that in the progress of chemical and mechanical inquiry and experiment, means and agents may be discovered which shall render the drying process in dressing innocuous, and the atmosphere in which it is carried on cool and healthy.

The business in chemicals and dye stuffs for bleachers and dyers, in starch, gum, and other materials used for dressing, has necessarily become very large. A piece of cotton net, weighing in the unbleached state 15 lbs., will increase in proportion to the dress required, so that if 'Paris' dressed it will become 60 lbs. weight, and the edges will cut through the skin like a saw. All nets for foundations of bonnets and similar purposes are thus weighted and stiffened. Such articles have been enormously used in this way, but are subject to the fluctuations of fashion, or the rise of the materials used, and consequent advances in price which may lessen or destroy their consumption. The mere disuse of 'curtains' to bonnets, lowered the returns of one finishing lace house some tens of thousands of pounds in one year.

CHAPTER XXI.

IMPROVEMENTS IN DOUBLE TIER LACE MACHINERY.

Before proceeding to notice several other modifications of importance, it may be premised that there were many references to Mr. James Sneath in the discussions upon the traverse warp trial. It was asserted, Brown and Freeman finding they could not complete their design, sought his aid, and perfected it by his skill. On this account further particulars as to himself and his connection with Brown and Freeman have been sought out.

James Sneath was a frame-smith and setter-up, living in Mansfield Road, Nottingham. His employment at first was chiefly amongst point net frames, but as they declined, the use of warp machinery increased, and he entered upon its construction. His acquaintance with the principal makers was the origin of his association with Brown and Freeman in 1811, and thus becoming practically acquainted with the construction of the lately invented twist lace frame by Mr. Heathcoat, through its specification which was early in their hands. No doubt the smithing for their travestied imitation was done in James Sneath's shop in Coalpit lane, which will account for Brown and Freeman's disappearance from Radford. In addition to the constructive skill Sneath himself possessed, the next neighbour to this shop was James Tarratt, a good mechanician, who was at this time a frequent visitor. It is not improbable he also might aid in getting the difficult problem solved. The surprising character of the traverse warp machine, and the comparatively short time occupied in its inception and completion, however it may have been brought about, must still appear a mechanical marvel; but the


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surprise is lessened, if it were the result of the combined skill derived from these three sources operating on the materials furnished by the patented machine, with the assistance of one at least of the Loughborough workmen at their deliberations. During the time the construction of this imitation of Heathcoat's frame was going on, Sneath told Timothy Richards, that he thought he should master its being made different to Heathcoat's frame.

Upon the completion of the traverse warp machine, and a number being made, Sneath went with them to Warwick on Mr. Nunn's account, was there in 1813, and remained there some years in the management of them. From thence he removed to Croydon, where he assisted William Sneath in an unsuccessful attempt to make a platted net machine.

It had a set of warp threads on a beam; and a set of bobbin threads on a bar operating in some way like the carriages in the present twist machine getting a twist by two motions. Further than this the movements are now not known; the particular result and cause of failure however was, that while one half the work was of a regular twist and plat, the other half of the breadth shewed a rough surface as if made of single yarn, the reverse movement of the bobbin and carriage bar having untwisted the threads.

From Croydon, James Sneath went to a small factory at Bleak Hills, Mansfield, where he placed and worked bobbin net machinery. He died there a few years ago much respected.

Having risen by his steady industry, combined with mechanical skill and general intelligence, to a respectable position in society, he brought up his family comfortably, and gave them a good education, fitting them for the discharge of the duties of life—an example that might and ought to be more generally followed by artizans of every class.

Mr. William Sneath, above referred to, was born at Linby in Nottinghamshire, about 1800. He was taught by his father to work in the warp lace frame. When two and four course net, with blonde and Mechlin from warp frames, had nearly gone out of use, Sneath, sen., John Kendall, Henry Leavers, and Cockayne, with James Sneath, jun., often met to talk about machinery. It was thus William Sneath got into the

twist net trade; for Kendall and the others were early connected with it. Soon after Heathcoat left Loughborough, William Sneath went there to overlook Linthwite's machines. They were 'old Loughborough's,' and he made an improvement which helped to continue their use for some time. Returning to Nottingham, he purchased a circular bolt machine, and in 1831, invented the plan which had never before this been effected on any machine, of producing spots, 'Points d'Esprit,' on the circular comb system.

He selected spotting carriages to lap for the spot, letting the main body of carriages remain stationary, retained by pickers, while the spotting carriages were propelled backwards and forwards by driving bars, having three extra point and hook bars to take up the spot.

Mr. John Hind at first took a share of the responsibility in bringing out a patent, No. 6208, for this invention of great and permanent importance. Spots of wattled basket work add to the value of many cushion laces; they are too beautiful and useful ever to go out of fashion. On J. Hind relinquishing his share of interest in the patent to Mr. Fisher, with William Sneath's consent, it was agreed "that each should build twelve spotting machines in succession; and that after these twenty-four, for which neither was to pay tribute, all constructed beyond during the patent should be built by or pay tribute to Mr. Fisher." Thus, William Sneath's interest in his invention, was that derived within the patent-right from the profit of working twelve machines. The profit resulting to Fisher was very considerable indeed. One Mr. Pearson took the plan to Calais, and also gained, it is said, a large sum by it.

After the above transactions, William Sneath continued for some time in the manufacture of lace, but eventually took up his abode and died in the house of his son, Mr. George Sneath, a magistrate of Midhurst County, in West Canada.

John Litchfield devised an arrangement for spotting on the Levers' machine. It was patented and disposed of to Mr. Fisher, who received tribute for its use; but upon a contest with Mr. R. Birken (who produced spot

on Levers' in 1833), backed by many machine holders in the trade, the patent was rendered partially inoperative. Freeman, of Tewksbury, made a spot on traverse warp also about the same time.

Mr. William Morley was an ingenious fitter and setter-up of stocking and point net lace frames in Nottingham. He began early in life to endeavour to improve the machinery in which he was employed, and which led him to introduce the use of a 5-bar tackle, or apparatus on the point net frame. Before the year (1811) closed, a simplification and consequent improvement upon his plan took place, whereby 3-bars were made to operate with equal effect; and their operation, singularly enough, was performed by *six* different methods, hit upon by as many mechanics. The Mr. Kendall mentioned in connection with Mr. William Sneath, being already engaged in making bobbin net, was joined by Mr. Morley, who in 1812, constructed a machine known as the 'straight bolt,' from its differing from Heathcoat's, in which the carriages went backwards and forwards in combs forming a segment of a circle, and therefore called the 'circular comb.' Kendall and Morley's machine was an infringement of Heathcoat's. Though not an improvement as to the shape of the bolt or comb, it was so by the simplification of several other parts, by putting in spur selvage wheels, and in the mode of changing the carriages on reaching the selvages, which resulted in greater rapidity of movement. In consequence it was much used during a few years.

Soon, however, Mr. Morley saw that the defective irregular net, resulting from the unequal length of thread drawn off upon his straight bolt plan, was irremediable, and he returned to the circular comb, from which it is singular that so clever a mechanician should ever have deviated, except for the purpose of dissimilarity to that extent from the patent.

In doing this, a great improvement was made, by reducing the bolts from four shorter combs as in Heathcoat's frame to two longer segments of circles as at present in use. He used pusher bars below the circular combs instead of above them to carry along the carriages; and nothing could be more smooth and regular than the movements

under the impulse of double bladed lockers of the carriages and the amount of thread given off from the bobbins they contained. He put his machines thus improved upon rotary action and worked them by steam power.

No modification of any importance in the manufacture of plain nets, for which these machines are specially adapted, and to which they are generally applied, has since been made, nor is likely to be. The superfluous parts of the insides of the machines were taken away, and the speed was at once increased from three to at least four racks of 240 meshes each an hour. For these practical improvements the trade has been eminently indebted to Mr. Sewell and Mr. Morley. While meditating and perfecting his double locker rotary machine, the latter was observed to be unusually thoughtful and absorbed. He was never talkative, but now for a time he displayed unusual reticence. Notice was given for a patent in March, 1824, No. 492, but it was never specified. At length the plan became known, and was highly appreciated, as the one on which plain net must chiefly be made. He had quietly constructed a large body of this machinery which brought to his house great profits forthwith, and his judicious and scientific management of hands and machinery, placed the firm at the head of the plain net manufacturers for the Nottingham market up to the present time. The mechanical skill possessed by Morley was amply vindicated by this machine, and his technical skill is seen in the excellent description of it furnished by him, and inserted by Ure under the article "Lace" in his works. This writer's prejudice against Heathcoat, no doubt arising from Mr. Morley's early chagrin on account of an injunction granted for infringement of the patent, is to be gathered from his withholding the merit of invention from the patentee, while it is given to several on account of their modifications of the machine.

The question of whether Heathcoat is entitled to the honour of being the inventor of the bobbin net machine or not, has been already discussed in these pages; our present duty is to do justice to one whose talent lay emphatically, not so much in invention as in simplification—a science which is, however, only

second to that of the inventor himself. As was the case in every other instance of success in management of bobbin net machinery, Mr. Morley had the perfect confidence of his workmen. He understood the machine as well as the most experienced of his hands, knowing what could and what ought to be done, and the best way to do it. The men willingly obey such a leader, and only such; and it has resulted, that amongst these machine hands there has arisen a body of skilled artizans, equal to any and superior to most, in the whole range of manufactures.

Mr. Morley was a man of excellent common sense, plain in his manners and habits of life; his great success did not unduly exalt him above those who started in a similar career with him, nor induce any perceptible departure from the simplicity and economy of his early days. He retired from his connection of thirty years continuance with Messrs. Boden's, of Derby, (by whose partners the business is still carried on) in 1853; at his death, which took place in 1855, at the age of 70, he was possessed of large property.

Mr. Thomas Robert Sewell was almost an entirely self-taught artizan, having received only the rudimentary education given by respectable parents in humble life. He was born (about 1788) in or near Nottingham, and he improved every opportunity that place afforded him of obtaining general and more especially scientific knowledge, assiduously and successfully. He soon became known and esteemed for his talents and the use he made of them. In process of time he acquired considerable skill in mathematical, chemical, and some other branches of science. But the chief bent of his mind was toward mechanics, which at that time opened up a field for study and enterprise of vast extent. He early acquired a knowledge of the construction of the stocking-frame and the point net loom. The net produced on the latter when compared with that obtained from its new rival, the bobbin net machine, he deemed so inferior in quality and beauty as to decide him to give attention to the manufacture of bobbin net, notwithstanding the secrecy maintained in regard to everything connected with it. Examination

of the net led him to think he could accomplish the task of constructing a machine to make it. He saw a bobbin net machine for the first time in 1818; and at first it by no means pleased him, not agreeing with the notion he had entertained of what a frame intended for such a purpose ought to be. He was erroneously given to understand that it was of the description then used by Mr. John Heathcoat, who had justly acquired great reputation as an inventor, and therefore purchased one capable of making net a yard in width in ten-point guage. A few only produced net more than 45 inches in width. For making this 36 inches net he paid the workmen 3*s*. per rack. He soon became dissatisfied with the machine in its then state. The movements were numerous and intricate, there being eight handles and two treddles necessary to effect them. When out of order and a stoppage took place, the workmen would forget the next proper movement and mistakes were made, time was lost and the net wrought seriously damaged. The wages though apparently high, did not always give satisfactory weekly earnings. Having seen two straight bolts in process of construction upon an ingenious modification devised by Mr. William Morley, of Nottingham, he considered the plan a great improvement, and purchased them. One was a 54-inch and the other a 72-inch, the greatest width made up to that time. But this class of frames, even in the hands of Allen, Kendall, and Morley, at first passed the bobbins and carriages through the warp threads eight times or sixteen motions, when Sewell saw that six passes or twelve motions would suffice. He added the further improvement of shortening the 'take up' by the points. The machine though still requiring dexterity in the workman was reduced to four handles and two treddles, the speed was increased one-third, the wear and tear diminished, and the net improved.

'Quillings' *i.e.* net in narrow widths, were now produced on these machines, but they had 'saw' edges. The extra warp threads used in wattling these breadths together pulled the bobbin threads which passed round them so much as when withdrawn, to leave a series of unequal and unsightly loops on the edges. These depreciated the value of the article greatly. A remedy was therefore sought for; and after much study Mr. Sewell found that the 'turn

again' used at the edges of the wide frame might be made to operate at any point or points in the width of the double-tier machines. By this process the two tiers were left complete, and the breadth selvage warp threads were laced together; and being perfectly tight, when the lacing thread was withdrawn, the edges were without any loop or irregularity at all. This 'turn again' at pleasure was effected by introducing a compound driving bar instead of the plain one; and it was so slit as to allow the lacing bobbins to fall out wherever that was necessary, and thus prevent them traversing with the rest.

For secrecy this principle was first applied, in 1820, to a forty-five inch frame at the house of Mr. Kendall. Being successful, all their machines were put on with it. The plan has since been brought into extensive use, as by it double-tier machines can be made to produce elegant open works, the large holes therein having selvages formed perfectly on their inner sides.

Mr. Sewell's next efforts were directed to still further simplify the machines and increase their speed. In endeavouring to do this, he was led to entirely invert all the parts of the double-tier, placing the warp beam above and the work beam below, the bobbins and carriages being moved under the arched combs, whose inner circles faced downwards, instead of over them as before. To this inverted arrangement was added an improved form of the carriages, enabling the two tiers to be passed through the warp threads at one sweep instead of two, and that by using only one locker to drive them instead of two, and by this one operation doing this part of the work so as to more than double the speed. This machine was capable of producing four to five racks an hour; the straight bolt, as he had before improved it, made only two racks an hour. By adding a simple crank motion he put this 'upside down' machine on with steam power.

Upon seeing these important changes, Mr. Kendall, whose partnership with Allen and Morley had ceased, proposed to Mr. Sewell to become his partner, which was agreed upon, and further machines of the newer kind were constructed. Mr. Morley had also proceeded to build 'upside down' frames, but without Sewell's simplified arrangement of parts. This accounted for the defective quality of the net made from them. But both these eminent mechanics agreed that the in-

verted machine required too much care on the part of the workman in regard to securing equal tension of the bobbin threads. This was a matter of vital importance, which might be secured without the sacrifice of much speed, by a still more simple arrangement of the *non*-inverted double tier machine. Each of them set about it in his own way, and about 1825-6 both had accomplished it, by retaining the method of passing the two tiers of carriages through the warp threads at one sweep. The 'upside down' machine had certain properties which, but for the Levers' frame absorbing the greater part of the fancy manufacture, would have most likely kept it in use for the like purposes.

Upon a dissolution of partnership with Kendall in 1831, Sewell erected a factory and constructed excellent circular power machinery at Carrington, upon which he made for many years three twist or 'Brussels' ground net from fine yarns, suitable for the application of pillow wrought sprigs and flowers. Here also he arranged this class of machines so as to secure increased speed without depreciating quality.

In his 'rolling locker' machine driving bars were dispensed with, and only a front and back locker bar used, which being moved by rack work and carrying both tiers of carriage tails, (fluted to correspond with the rollers), to and fro at one sweep, passed them through the warp threads with safety and great velocity. Some years after he patented, No. 6936, an improved 'turn again' including extra bobbins for embroidery in this class of machines. On the whole it may be doubted whether the wear and tear by weight, vibration and friction, of the rolling locker when pushed to the enormous speed of which it is capable, may not prove a counterbalance to its profitable use.

In 1841, by applying a straight bolt to each guide, and putting all under the control of the Jacquard, he produced patterns in wide nets in outline cloth works, ticking them on the edges, and throwing in beautiful open works so as to give light and shade, and produce a rich effect. He drew all his own patterns, many of which were in excellent taste embodying ideas derived from his careful study of the enrichments in Greek architecture. This modified machine was exhibited by him in 1851, and being purchased by the Prussian government, was put to work by him in the public school at Elberfeld in 1852.

Mr. Sewell made on his thirteen-point machine a beautiful net, in which four sides of the mesh were twisted and two platted. Using No. 300 yarn, and working it twenty-four holes to the inch, it was equal to the best pillow plain net, but found to be too expensive for general use; made half guage and of heavier yarn, this article has a graceful effect in window curtains.

It has been already mentioned that Mr. Sewell was practically conversant with chemistry. Our account of him would not be as complete as his knowledge and efforts to make himself useful deserve, were not his several patents in this department enumerated. We are not competent to judge of their merits.

In 1837 he took out No. 7280, for a mode of combining oxygen with lead by combustion of charcoal so as to produce protoxide of lead; and a further mode of preserving the carbonic acid gas generated for the purpose of carbonating protoxide of lead and producing ceruse of white lead; also the apparatus for doing it. In 1838, No. 7736, for a method of manufacturing oxide of lead to be turned into oxides of litharge and massical. Also a superior quality of white lead composed of more metallic lead and less carbonic acid than are commonly used, the carbonic acid being in better state, also to purify or wash white lead more perfectly. In 1840, No. 8765, for obtaining carbonic acid pure and at a small expence from minerals containing carbonate of magnesia. In 1848, No. 12030, for improvements in making flour so as to admit its being kept for several weeks and subsequently being made into bread without using yeast. This he proposed to accomplish by a superior method of combining hydrochloric acid in which were one equivalent of hydrogen and one of chlorine, with bi-carbonate of soda in which were one equivalent of oxygen and one of sodium, these applied in the way described in his specification to the fecula or starch in flour, the hydrochloric acid is immediately absorbed and remains inactive till the flour is wanted to be made into dough by the process specified. Mr. Sewell also devised a new method of making artificial manure.

Mr. Sewell, it has been well said, is a representative man, of whose abilities the class of mechanicians may be proud; while the suavity of his manners and high integrity of his character made him the object of affectionate regard to friends and fellow-citizens, who regretted that in the evening of life he should seek an Australian home. The writer of these pages may be permitted, after thirty years' intercourse, to record the esteem he has ever felt for the subject of this short memoir.

CHAPTER XXII.

MR. JAMES FISHER AND MR. WILLIAM CROFTS.

Mr. Fisher was identified with the bobbin net trade from its commencement in several important respects. He was born in Cumberland about the year 1775. His father occupied a farm in that county, but by a singular and painful accident which occurred to one of his sons, the three other brothers successively decided to quit their home and occupation, and seek their fortunes in trade. Of these, James the second son, was the first to proceed in search of employment, which, it is said, he found in the shop of a London haberdasher. Shortly after he had attained manhood, he was noticed as an active and intelligent traveller for the disposal of Buckinghamshire lace goods, principally in the northern and midland districts of England. No doubt he early acquired in this difficult school that knowledge of men, and insight into the principles of trade, which lay at the foundation of his future success. He was distinguished for his acquaintance with the best sources from which the goods he dealt in might be drawn, and with their quality and value. He combined a just taste in their selection, with an unswerving resolution to make them bring a profit. His first purchases in Nottingham lace were made from C. Lacy, afterwards his brother-in-law, who was in the point net trade. At that time, 1800, this connection was valuable to Fisher.

Upon entering into the business of a wholesale London dealer in lace on his own account, he determined to build up a concern that should be both extensive and profitable. He sought and obtained for his customers in London and the provinces first-class traders. Punctual himself, he required punctuality on their part,

if distrust were excited, explanation was sought, which if not satisfactory, closed the account. The town and country connexion of this house from 1812, was cultivated with such vigour, as seemed to render want of success impossible.

While making steady advances in a business, which extended at length to most of the principal towns in the kingdom, as well as in all his subsequent management of it, he required on the part of those he employed, the same promptitude as from customers. Although dissatisfaction with his travellers, sometimes not on the most material points, might probably be the signal for their dismission, there was one extraordinary exception to these sudden determinations. Like most men of great administrative talent, Mr. Fisher gathered round him very active clever people to carry on his operations. Several such have since become well-known. One of them became a partner in his London house, and represented it for some years on the west of England commercial circuit. This person used to boast, that his allowance for travelling expenses was £1000 a-year. He astonished even old commercial travellers and helped to ruin younger ones, by daily excessive indulgence at the dinner table, and by nightly dissipation. His talents when engaged in business were confessedly unsurpassed. In whatever way the preceding evening had been spent, at nine in the morning he was prepared for his customers, whose accounts being first paid, sales of surprising amounts were frequently effected. His Sunday dinner bills were sometimes enormous. On one occasion, including broken table, pier, and window glass, the charge amounted to upwards of £10. Such insane profusion rendered it at length impossible for the head of the house to retain him. Thus was lost one of the best partnerships in the metropolis, with the certainty of an affluent position for life. After a few years spent, partly in America and on the continent, this unhappy man returned to London, broken in constitution, and almost without resources. Mr. Fisher, hearing of his state, sent a physician to alleviate his sufferings, and a friend with means to administer to his necessities. He refused

both, and soon after died. As a contrast to the example of Mr. Fisher, who had passed unharmed through the seductive influences of the commercial room and the road, and attained a station of such eminence, the history of the lace trade would have been incomplete, without some record of the talents and end of John Hughes, its most noted salesman in the west.

Some time after Mr. Fisher's commencement of business on his own account, being at the warehouse of Mr. Lacy, he was shewn a sample of the bobbin net then just produced, approved of it, and bought the first parcel of this article ever sold. From this time he entertained a high opinion of Mr. Heathcoat's ability, and showed a growing interest in his machinery. His purchases of bobbin net became very large as his business increased. In 1847, nearly forty years after the first expression of his favourable judgment of the invention, Mr. Fisher presented a likeness of Mr. Heathcoat, painted by Pickersgill, to the Nottingham Mechanics' Institution, saying, "that the portrait of one of the foremost mechanicians of the present day would be suitably placed in the locality where the first triumph of his genius was achieved."

After the expiration of Mr. Heathcoat's patent in 1823, Mr. Fisher began to embark capital in buildings and bobbin net machinery at New Radford, near Nottingham. This was increased rapidly, until the outlay became very large. His attention was early and strongly directed to the possibility and importance of making such alterations and adaptations of the various kinds of machines, as would produce plain nets more rapidly and cheaply; afterwards slight then closer imitations of pillow lace grounds were got off the frames. This opened up the way more clearly to the steps necessary to secure the mechanical skill which might place further inventions in his own hands.

In narrating John Levers the younger's connection with the lace trade, the three first patents taken out for Mr. James Fisher are mentioned, Nos. 5622, 5741, and 5940, and the dissolution of their partnership. In 1831, Mr. William Crofts had constructed a machine for making a net, called, from its being made round like

a sack, "sack bag net," and from the formation of its meshes "fender" or "pantry-window net."

The machine was a rolling locker single tier; it had three distinct comb bars and two warps coming from two separate beams at the back and front of the middle comb-bar. The carriages passing through both warps made two pieces of this net traversing round at the selvage.

This machine excited considerable attention at the time, but as there was and could be no traverse, and consequently no solidity in wear, it soon fell into disuse. A similar article, made in a different manner, has been again for a long time largely made.

Crofts was already known as one of the quickest and cleverest hands working in a Levers' frame. The machine just described, shewed that he perfectly understood the principles upon which it is constructed. He rapidly acquired an accurate knowledge of every other kind of bobbin net machinery.

Upon the exit therefore of Mr. John Levers, jun., from Mr. Fisher's manufactory, Crofts took his position as principal mechanician of the establishment, and in his name the eighteen patents, including thirty distinct constructions, about to be referred to, were taken out on his principal's account. These he specified for, and must at least have understood and assisted in drawing out specifications for, whoever the inventor might be. But from the nature and extent of the alterations and adjustments of the original machinery, required to produce the varied results obtained under these patents, it is very certain none but a man of very clear mechanical mind could have successfully fulfilled the responsible duties which Crofts undertook. The trade is no doubt indebted to him for devising important improvements of his own, as well as bringing into successful operation those of others.

The following is a brief and as intelligible an account of these patents, and of the many matters for which they were taken out, as the nature of this work will allow:

The first patent obtained by Crofts on behalf of Fisher, was for Bagley's lever honeycomb invention in 1832, No. 6229, as mentioned

elsewhere. The next was, No. 6349, for making breadths on a rolling locker machine, also in 1832.

In this year also Crofts made spots on a double locker frame by breaking out the main guides and replacing them by active guides.

Again, in 1833, No. 6382, a rolling locker circular machine for making breadths, but it would not work safely.

And on the same day, No. 6383, for bobbin net machinery which was combined and actuated in a new manner.

Another, in 1833, No. 6447, is a double locker breadth machine in which the locker is cut in nicks to let carriages remain untraversed and using pickers to hold them back, and having pins to fill up interstices acting from extra bars.

In 1834, No. 6618 was for making pusher net by carriages working upside down, and which were acted on by pushers like jacks, moved by an organ barrel. To lay in weaving threads, a large wheel is placed on the side of the machine. It had in the whole three organ barrels. This machine was very complicated and but little used.

Again, in 1834, No. 6717, for ornamenting lace on a treble bolt and comb bar machine, having front and back bolt bars, double tier; and middle comb bar, single tier. Between the three bars come up two warps. The carriages are turned upside down and the tails are worked by hook pushers operated upon by an organ barrel to draw the carriages; the Jacquard not being yet applied.

And, in 1834, No. 6739, also for ornamenting lace on a Levers' machine having six extra guide bars and two extra cotton beams. In making the net there are nine motions to the hole; to avoid hogging the twist, the points take from the carriage heads.

In 1835, Crofts took out what is called his monster patent, No. 6854, from its enormous length of specification, (filling 149 pages, and requiring forty-nine sheets of drawings, many of them of no little intricacy), as well as from the significant fact that it claimed and described nine professed inventions or improvements in the manufacture of spotted goods and cloth works—four on pusher, three on circular, and two on Levers' machines. The cost to Mr. Fisher of taking out the patent for these machines, was said to have been from £4000 to £5000, and must have been very great; the cost to the Patent Office of their 250 published copies has been £250. The reason for this outlay by Mr. Fisher was not at first sight very apparent. It is probable, however, that the success consequent on the use of the first spotting patent bought from Sneath, and the advantage attending a perfect control over the production of every article, into which a *spot* was introduced, even to the narrowest fancy edging or insertion wrought upon these classes

of bobbin net machinery, was seen to be of such magnitude and importance, as to convince so keen a man of business as Mr. Fisher that any outlay, however large, for such a purpose, would almost certainly more than repay itself. Moreover, a series of patent rights would render excellent service under the competition to which his country trade was now subjected, by securing priority of novelties and leading articles in meshes, ornamentation, and style; enabling him to keep the precedence, which, by his talent and energy, he had for a quarter of a century maintained in the supply of machine-wrought lace. The plan so far succeeded that the trade in wide spotted nets has ever since remained for the most part in his hands, his machinery being continually engaged in its manufacture.

Croft's patent inventions, in this prolific year, 1835, may be briefly stated as follows: (1) A method of weaving on pusher machines by using five cotton beams, seven extra pusher bars, three extra guide bars and two weaving guides which operated between pusher and comb bars, two worms conducted the point bars. (2) A method of making spots on pusher machines by two extra cotton beams without stopping the machine. (3) Another method of making pusher spots. (4) An improvement on his former patent, No. 6618, in 1834, by applying a particular kind of combs instead of bolts for guides to hooked pushers. (5) A circular comb frame in which the spotting threads were slackened by a drawing bar and carriages which make the spots when moved by pushers. (6) A machine for making spots on rolling locker and on double locker frames by throwing the main wheels out of gear and moving the spotting carriages only. Champollier, of Calais, and Machien, of Lisle, have gained a suit in the French courts, which has decided that this is not an infringement of Sneath's method. (7) For spotting on double locker frames. There are nicks made in the locker bars which hold back the carriages while the spots are made. Slide plates fill up the interstices when the plain net is making. The front points are of two lengths, the long ones take up the spot and lodge the cast thread of the spot upon the back points. This frame has five cotton beams and six guide bars. (8) A method of making blonde or straight down net, the carriages and warp only traversing a mesh or two. The spotting is effected by the use of extra guide bars on the circular bolt machine by throwing the main wheels out of gear while spotting. (9) A method of making spots on a circular machine with extra guide bars and extra cotton beams, not stopping or throwing the main wheels out of gear while spotting, the spots being made by extra warp threads. (10) Making spots on *rolling* locker machine, by using extra guides and extra beams, and throwing the beam wheels out of gear while spotting. (11) A method of performing the same spotting process on a *double* locker as that last described.

(12) A method of making Levers' spots, by breaking out the main guides where the spot is required and substituting extra guides. The main body of the carriages is at rest while the spot is made. This plan not used. (13) A method of spotting blonde or straight down net, by shooting in two extra threads and working without pusher bars, thereby reducing the labour considerably. (14) A plan for making honeycomb net from circular bolt machines by breaking out the main guides where the honeycomb is required and filling up the space by two taping and four filling up guides. There are eight guide bars and four thread beams in this frame. The point bar is worked by an eccentric wheel. (15) A plan for making honeycomb on *rolling* locker frames. And (16) one for making honeycomb on *double* locking frames. In 1836, Mr. Fisher, by Crofts, patented a plan, No. 7190, for an application of the Jacquard to the bobbin net machine. And, in 1836, No. 7345, methods for figuring and ornamenting bobbin net twist lace and other fabrics. No. 7638, was the patent taken out in Crofts' name for Bagley's double warp platted lace described in the account given of the latter inventor; but it also included making spotted and honeycomb nets.

In 1839, Crofts took out, No. 8038, a patent for making ornamented lace and net of various kinds.

In 1840, No. 8430, for twisted looped or woven fabrics by the application of Jacquard caids, using Levers' jacks acting on stumps which entering the warp threads when the stumps were pressed forwards, the levers removing the warp threads over more gaits than one, thus made linen work or large holes when required. Again, in 1840, No. 8690 was taken out for a straight down spotting Jacquard machine. And finally, so far as Crofts' patents on behalf of Mr. Fisher are in question, in 1842, No. 9467 was obtained for an improved method of manufacturing figured lace.

It will have been noticed that these patents were not only for the fabrication of certain diverse woven objects on the three great classes of bobbin net machines—pusher, circular, and lever; but also for different mechanical modes *in each* of accomplishing these results, as by double or rolling lockers, stumps, or Jacquards; and thus a series of shackles were put on the free use of machinery by a great capitalist, who on the one hand was a very large producer of machine-wrought lace, and on the other, had risen to be for many years one of the largest purchasers of every class of finished goods in the market. These facts combined to produce on the minds of many mechanicians great disinclination to seek for useful adaptations of bobbin net machinery, under fear of litigation and penalties for infringement. At length meetings of machine owners were held upon a subject felt to be of the greatest importance to the trade, and which had, in 1835, drawn the earnest

attention of a large part of the owners of lace machines to the serious position of the trade.

A short abstract of the address of this body, and their plan of association for the encouragement, protection, and throwing open for general use, inventions and improvements of machinery employed in the hosiery warp and bobbin net trades, is as follows:

"These machines are capable of very great modifications, calculated when effected to much increase their value, and use and open up new sources of employment and profit. Skilful persons often suppress such inventions (some of which have afterwards proved of much value) because unable to bring them out, so as to secure any profit resulting from them. Some have been ruined by costly experiments, which others have beneficially appropriated. English inventors, being generally in humble life and not able to encounter the expense and uncertainty of our patent laws, carry them abroad, where, as in France, an inventor can secure the fruits of his skill at little expense in time and money. If they could command security for the profit of their inventions, they would apply to them all their skill and ingenuity; in the exercise of which, is to be found all our advantage in competing with foreigners, and ought therefore to be fostered with the utmost solicitude and care." The plan was—"To raise by instalments a fund of £10,000, to be invested in the names of trustees then appointed; and by subscriptions of machine owners and traders, mechanics, workpeople and others, to pay current outlays, premiums and expences. This fund to be under the control of a board, deciding on all measures finally, and reporting annually. One sub-committee to be composed of members competent to understand and decide upon the value of improvements and inventions offered for purchase or remuneration, and to report thereon to the board. Another sub-committee to watch proceedings under the patent laws and manage the legal department, reporting upon them to the general board. The association to be so constituted as not to form a combination to limit trade; or interfere with the lawful exclusive right to the use of machinery and inventions; or by seeking any profit to the members as such, to form a partnership, or render liable to any claims beyond the amount of their several subscriptions. But it is intended to be so constituted as to prevent fraudulent assumptions of patent rights and their undue accumulation, through fear of expensive legal processes, and thus restraining the assertion of individual or trade rights to the use of inventions; and chiefly to stimulate skill and ingenuity by the prospect of a fair reward, and, as far as possible, securing it to them."

Scarcely any inventions or modifications of machines were brought under the notice of this board, no doubt from the idea cherished by each constructor of possible gain by patent rights from any new combination. But the fact that it numbered amongst its members the holders of three-fourths at least of all the machinery in

the lace trade, and was supported by the sympathy of the hosiery trade, was too significant to be slighted. And although, from 1835 up to 1838, Mr. Fisher sent out repeated notices to every maker and dealer in lace, that neither, at first spots, nor afterward plats, might be safely bought from any other than his authorised agents, the feelings of masters, workmen, and buyers were loudly—sometimes, by small makers and men, intemperately—expressed in opposition. This culminated in a resolution to try the validity of the spotting patents taken out by Fisher; and in April, 1838, at a meeting, held in the Exchange Hall, of sixty highly influential owners of hosiery, lace, and yarn doubling machinery, presided over by J. C. Wright, Esq., banker, nearly £2000 was subscribed, and the following address was issued:

"It having been unanimously admitted at this meeting as an undoubted and incontrovertible fact, that most serious injury is accruing to the trade from the extent to which ingenious mechanics are carrying their inventions to the continent, and the causes of this most alarming and increasing evil being also unanimously declared; it was agreed that the proposed society was the best and most legitimate mode of securing the just rights of ingenious artizans, and of retaining and fostering native talent in our own country."

The committee appointed consisted of fifteen members, of whom five were magistrates, and Mr. Wright was treasurer.

The object in view and the manner of pursuing it, were mainly those described in the address of 1835; but had even more special reference to mutual protection against actions for infringements. To prove the extent of intrusion upon the free action of the bobbin net trade, it was shewn that Crofts had then fifteen patents running; besides which there were forty unexpired taken out by other parties, some of which were also in Fisher's hands. Gradually less was heard of infractions of patent rights; till, in October, 1847, an action, which had long been pending between Fisher and Crofts, and Oliver and Atkin, to try the validity of the patent for Bagley's plat nets, and to which the defendants (backed by the trade) had put in one hundred and ten objections, the expences having been already large, both parties tired, and the issue doubtful, a compromise was ar-

ranged; each party paid their own costs; the plat claim was allowed to Fisher and Crofts, while Oliver and Atkin were to have a right to make the eighteen patterns (being only double warps in certain parts) alleged to have been infringements,—leaving as an open question whether wicker fine work made with a double warp, and broken into meshes, was or was not an infringement of the plat patent.

From this time hostile interference on the part of Mr. Fisher with the trade practically declined, and at length ceased altogether. The factory and machinery for making bobbin net is still carried on at Radford, by Mr. James Fisher, of Scotholme house, his eldest son. This gentleman is a highly educated and talented graduate of Cambridge University. The purchase of goods in Nottingham for finishing, largely carried on for years by this house, has since the death of Mr. Fisher been given up. His London business reached its highest point probably about twenty years ago; since which it has somewhat declined, and is not now in the hands of the family.

Mr. Fisher was a personification of method in carrying out sound principles of business determinately to their appropriate end. In their steady development there was neither intermission nor change; and every one who knew him, saw in that fact the ground of well-earned prosperity. He willed success, and he won it; becoming the master of an excellent business and large property. He only ceased to manage personally his weighty affairs, when attacked by the disease which rapidly brought him to the grave. Mr. Fisher died at his house at Dulwich in 1849, aged seventy-four. His opinion and judgment in matters of general commerce and national manufactures were highly appreciated at the Board of Trade, and well thought of by first-class men in the city.

After quitting Mr. Fisher's manufactory, Crofts in connection with Gibbons, in 1844, took out No. 10,370, a patent for making velvet patterns on circular Levers' bobbin net, by the Jacquard operating on stumps which acted upon the warp threads, producing various textures. The same year, in concert with Dunnicliff and Bagley, a patent, No. 10,390, was obtained by him for lace and other weavings. And

finally, in 1846, No. 11,344 was taken out by himself alone, for a similar class of productions obtained by means of pattern surfaces acting on independent instruments, so as to slacken bobbin threads at will, in single tier rotaries.

A method of producing pattern originally devised by William Herbert and perfected by Crofts was intermediate between the use of the chain wheel which was cumbrous and expensive and the Jacquard. It may be described as a pin pattern surface plate machine. If 112 pins in 4 rows of 28 in. each be placed lengthwise to each guide bar, the plate recedes and advances to and from the machine and at 28 removals; the bolts shog from one line of pins on to the other, and have the same powers in action as an eccentric cut wheel having 113 rises and falls. The pins are of unequal lengths, and by merely taking one out and replacing it by another in the progressing plate, the pattern may be changed nearly as quickly as printing type is set.

Mr. Crofts in the decline of life is not in the enjoyment of those pecuniary results which his mechanical talents have undoubtedly deserved. For more than thirty years his great abilities were devoted successfully to the mechanical subordination of the separate threads of which lace is composed, so as that exact imitations of various kinds of pillow lace might be obtained. In the retirement of age it will be pleasant to him to know, that in the judgment of many others he has attained a high position in practical mechanics.

CHAPTER XXIII.

THE BOBBIN NET LACE TRADE.—1823 TO 1836.

WATER or steam power had been applied several years to bobbin net machinery in the larger establishments, but between 1820 and 1822 it was much more so, and was the means of drawing machines into factories on all hands. Every thing combined to lead the people in Nottingham and its neighbourhood, to expect golden times when the patent shackles were removed. In consequence, through the years 1823 to 1825, a time of unparalleled prosperity, capital flowed into the business abundantly from bankers, lawyers, physicians, clergymen, landowners, farmers, and retail dealers, in order to construct new lace machinery. That which was already at work could be sold for three times its cost. Every available smith and mechanic on the spot was hired, and the wonderful wages offered, speedily attracted smiths and mechanics from far off towns. Day labourers came from the plough and strikers from the forge, for some of the latter got £5 to £10 a-week. Birmingham, Manchester, and Sheffield engineers and tool-makers met on one common ground; but houses were too few to lodge them; bricks doubled in price, and building land sold for £4000 an acre. Thousands of pounds were wasted in paying enormous weekly wages to people pretending to construct machinery, the movements of which they could not comprehend; and tens of thousands of pounds were drawn from speculators for machines, which, even if well constructed, could not possibly repay *them* their outlay. The inflation of the public mind was universal and became a sort of local epidemic—a mania, acquiring the name in after years of the 'twist net fever.' The whole community was athirst for gain, and became intoxicated. Nothing like it had ever been seen before in that trade

or probably in any other. Those who actually wrought in the machines had an opportunity to realise large sums of money. The provident generally, as was natural, put their gains in a part or the whole of a machine, paying for it by weekly instalments; thus becoming partly or wholly their own masters. The self-indulgent spent their time and money in a constant round of alternate work and pleasure. They would ride on horseback to and from labour, and having taken their shift at their machines, refresh themselves with a pint of port or claret on their return. Not a few of these spendthrifts were receiving parish pay or aid from public benevolence within the following ten years. The minds of many of the more ardent smiths and other mechanics became bewildered and overpowered, in the endeavour to overcome the difficulties presented by this intricate class of machinery, and they fell into insanity. When the speculative national frenzy of 1825, which had countenanced this more limited mania, collapsed in 1826, the effect in Nottingham and the district around was fearful. Visions of wealth and cherished schemes for grasping fortunes suddenly, were dissipated almost in a day. Many not in the trade, as well as some who were, lost all their means and fell into hopeless poverty; some died from despair; others went into self-imposed exile; a few destroyed themselves.

The patentee and licensees had in the time of prosperity put into operation the most improved and speedy machinery devised up to that epoch, and of course reaped the larger part of the profits that accrued. The demand for this lace net continued for some time to increase, until it became very large indeed; but the supply invariably went beyond it, and prices fell constantly. The prejudicial results of the unnatural and excessive increase of machinery, between 1820 and 1826, were very manifest in the experience of the trade during the following ten years. Meantime the immigration had been so great that the Nottingham of that day suddenly burst its bounds, not being able to contain the people, and has continued to overflow ever since—the population, which was 47,300 in 1810, when the twist trade begun, having become, in 1830, 79,000, and about 150,000 in

1866. The returns of this new branch of the lace manufacture were such as, when added to the extraordinary amount of wages paid for machinery, greatly to increase the circulation of money through the wholesale and retail trades of the town. Although Mr. Heathcoat disposed of the greater part of his Tiverton production through his London house, and Mr. Nunn also sent that of his Isle of Wight factory to be disposed of in the London market, Nottingham became from this time the emporium for the English machine-wrought lace, to which the goods have ever since been sent for sale, and where buyers resort to make their purchases for home and foreign trade.

Trade committees, both of masters and their workmen, had been watching the course of events in the bobbin net trade, through the last years of Heathcoat's patent, and their deliberations were deemed to be of still greater importance in the eventful time which it had been foreseen must inevitably supervene upon its close.

The masters' committee found in 1826 the machines thus located: In Nottingham, 650; Radford, 315; Hyson Green, 110; Beeston, 69; Basford, 62; Sneinton, 80; and elsewhere in Nottinghamshire, 150—total 1436. In Loughborough and neighbourhood, 240; and at Leicester and vicinity, 38; in Derbyshire, 78; at Tewksbury, 37; Shipton Mallett, 53; Chard, 49; Exwick, 40; Taunton, 100; Barnstaple, 34; Isle of Wight, 99; Tiverton, 204; Tottenham, 23; sundry other places, 38—altogether 2469 machines, to which number they had arisen from 970 in 1818.

The masters' committee ascertained also that during the speculations in machinery, prevailing from 1823 to 1826, Levers' eight-qr. machines sold for £700, circulars for £650, pushers and traverse warps for £480 to £550; during the first six months of 1826, though the working hours had been restricted to ten per day, the prices of Levers' sunk to £150, of circulars to £130, of pushers to £120, and of traverse warps to £80. An 'old Loughborough,' was purchased in 1822 for £1100, and was sold in 1823, just before the mart ceased its operations, for £700. A 'Greenwood' machine was bought for £250. Each was sold for £2, the day the mart was dissolved. This was before the 'fever.' A Derby workman told Dr. Ure that he had bought a machine for £230, by working which he had gained for a time £1. 10*s.* a-day,

and had sold it for £2 as old iron. During the 'fever,' £75 to £120 a-year was paid for the rent only of a six-qr. machine. Such a machine cost the builder £600; and £50 to £60 was often paid for being taught to work one. It was found that having no confidence in the continuance of high prices either of machinery or nets, many sagacious persons had realized their interest by selling both, so that of the then owners of machines, only one-third were originally lace manufacturers; and that of these not a few had fallen into difficulty, and some into deep distress.

The knowledge how to build this class of machinery had been in great measure confined, during the continuance of the patent, to the smiths' shops of the patentees and their principal licensees; but it had now been made a separate business also, employing independent skill and capital to a large amount, in order to meet a demand unprecedented in its character and extent. The subsequent fluctuations in demand for bobbin net machinery have been great; but the necessity felt by those who had thus embarked their means to keep their men employed, did then, and has ever since operated to, keep the supply of machinery up to an amount beyond the home demand for it, as well as that for France and elsewhere. The influence which surplus machinery must ever have upon any trade is very great. It forces production at whatever cost upon those who hold those machines and they cannot employ them, except at the risk of an unnatural pressure on prices and profits. The like pressure will come in due time on workmen's wages also—a result eventually of the greatest importance to them, as well as to their employers. That the business of building machines is different in its operation to that of producing consumable articles, is a truth never yet estimated at its real value in our practical trade economy.

The inevitable result of so great and sudden an addition to the machinery in the twist net trade was an equally rapid reduction in prices of nets and diminution in the confidence of buyers as to their ultimate value. Though very low in 1826, prices of nets had somewhat advanced in 1827: but so great had the panic in the lace market become in 1828, that the trade committee

called a general meeting of machine owners, at which it was resolved to institute a 'trade mart' for the purchase and sale of nets, partly on the principle of that of 1819, and partly on that of the Leeds cloth halls. This company was to raise a fund by 200 shares of £30 each, to be held exclusively by owners of machines, and the business directed by twelve such owners whose machines were working by power and twelve by hand labour. They were to regulate the working hours of the machinery. This scheme, however, it was found impossible to realize. A subscribed fund wherewith to purchase the goods as they were made, was found to be out of the question. It was thought that if many further machines were not built, and the working time of those already constructed could be sufficiently limited, the risk of loss to subscribers consequent on the mart plan would not be incurred, and the immediate interests of all would be consulted by the reduction of stocks and of supply, which such restriction must effect. At a large meeting, held on December 11th, 1828, including most of the principal owners or their representatives from all parts of England, it was unanimously resolved to limit the working hours from eighteen and twenty then customary, to twelve daily, for one month. On January 7th, 1829, another public meeting was held. The restriction had been adhered to almost universally, and it was resolved the twelve hours should be continued in operation. In March, the unanimity on the part of the owners of machines was such as to induce the committee to draw up, and offer for signature, the following draft of an—

"AGREEMENT FOR THE EXECUTION OF RESTRICTION OF HOURS' DEED."—

"A committee shall be appointed for better management of the bobbin net trade in England.

"That each person owning ten machines which are in work, or one person belonging to a firm owning ten machines at work, or his or their known agent, in the absence of the principal, shall whilst owning and working or causing the same to be worked, be one of such committee.

"That the owners of every two hundred working machines (independent of the above) may choose one representative who shall form one of the said committee; such last committee men to be chosen annually, and appointed by a written authority from such owners.

"That each committee man or known agent may appoint a proxy; such proxy being a member of the committee. It shall meet on the first Tuesday in every month, and at other times when needful, if called together by the president of the last meeting, and may adjourn from time to time. A president shall be chosen, who shall have a casting-vote when the business is to be decided by a majority. A majority of votes shall carry all questions except as after mentioned. In case of death, refusal or incapacity of one of the representative committee, the remainder of the representative committee may choose another until the next annual choice of the committee. Three-fourths of the whole committee to have power, after giving not less than ten days' notice by advertisement, to limit the hours of working and to control the same (including stoppage) in such way as they may think right, the assent of such three-fourths to be signified by their respective signatures. Machines are not to be sold or parted with, but so as to be subject to the present restrictions. In case of machines being worked contrary to the orders of the committee, a penalty to be incurred of twenty shillings for each machine for each day of offending. The committee to pay all necessary expences, and may reimburse themselves, costs and expences, from the money to be received from the penalties as far as the same will extend, and from the money to be raised as after mentioned. Funds shall be raised for such purpose by a subscription of threepence, or any less sum if directed by the committee for every quarter of a machine, the same to be collected quarterly from the date of the deed; payments to be due at the commencement of the quarter. The committee every Christmas to certify in writing signed by the president, the number of working machines in the trade, which certificate is to be conclusive for the following year. It is agreed that there are now four thousand machines in the trade at work. The deed shall from time to time be in force when executed by the owners of seven-eighths of the working machines; and may be put an end to by the signatures of the owners (parties thereto) of seven-eighths of the working machines. The present renters of machines signing the deed, shall stand in the place of the owners as to penalties and payments. No owner shall hereafter let a machine except to a person who shall sign a separate deed, binding himself to the above restrictions and to the above penalties and payments; and whilst such person rents the machine, the owner not to be answerable for the penalties and payments."

"*We the undersigned do mutually agree with each other to execute a deed upon the above terms and conditions, as soon as the same shall be prepared and made ready for signature. As witness our hands this 30th of March,* 1829.

(*Signed*) JOHN HEATHCOAT AND CO."

Working 206 machines and by 1252 other machine holders. The aggregate of machines represented held by these signataries and controlled by the committee was 3307; of these, ten held respectively 83, 71, 67, 60, 40, 39, 32, 28, 27 and 24; two held 23 each; three held 21, 20, 19 respectively; two held 16; and two 14 each; three, 13; six, 12; three, 11; and ten 10 each; these 43 houses having 1087 frames, had a right to sit and vote in the committee. Besides these, four persons held 9; eight, 8; eight, 7; eighteen, 6; twenty-five, 5;

sixty-seven, 4; one hundred and seventeen, 3; two hundred and fifty-two, 2; seven hundred and four held only 1 each; and eight had one-half share each in a machine. These 1211 machine holders had a right to send eleven delegates into the committee to represent their 2220 frames.

The total number of the frames in the trade was ascertained to be 3842 in 1829; so that signatures for fifty-five more machines would have made the deed operative. If desired these could have been at once obtained. But this was not deemed advisable, and the document was placed in the hands of the chairman, the writer of this work: where, with all the other papers connected with this laborious affair, it has since remained. This deed was not approved by a minority of the owners of about one-eighth of the machinery of the trade. One very large owner, who had supported the committee, withdrew in May; another, equally important, had signified his dissent by working his machines twenty-four hours in the day (which practice he maintained as a rule long afterwards), and much ill will was thus engendered, followed by some slight acts of violence. Stocks had been reduced by the end of June, so that there was only in the hands of producers less than three weeks supply. But though prices of the unfinished plain goods in widths of 12 qr., which had been forced down by a special competition, were raised 33 per cent., yet sales of other kinds were as difficult as before the restriction; and the confidence of the buyers of finished goods was lessened rather than increased by what they justly deemed to be the factitious interference of this committee with the freedom of manufacturing operations. The fact of two factories, one of 95, the other of 105 machines being worked unrestricted hours, added to the serious oversight that *the deed contained no restriction against an unlimited construction of new machinery*, was sufficient to break up the committee. On the 13th October, 1829, the resolution of the committee to give up their charge was made known at a very large meeting of the trade; and contrary to the wish then strongly expressed, and of the memorial sent by 1808 Nottingham bobbin net journeymen signed between 10 A.M. and 6 P.M. of that day, the committee

resigned; the deed was given up, and of course the restriction came to an end.

The whole transaction was, with the exception of one member of the committee, undertaken and carried on in good faith. The number of machines building was twenty-one in May throughout the trade, and in June seventy-one. But the latter did not include forty-four of 12 qr. width, which, by the time the deed was set aside, Samuel Hall (*not* Mr. S. Hall the gasser)—one of the most active promoters of, and workers in the committee of the restriction—unknown to the rest of the members, had put in rapid course of construction. The subsequent history of these machines is curious and instructive. The trade had become over loaded with plain net rotary machinery before these were ten years' old. They were excellently constructed and in working order, yet, though they had cost about £14,000, the lot was unsuccessfully offered by auction for £600 in 1838. In truth, as will be seen by the census of machines in 1831 and 1833 respectively, the mania for building lace machinery seemed incurable, however depressed and unprofitable the trade might be. There still existed amongst the Nottingham machine owners much jealousy of those in the west of England. Yet the bobbin net machine owners at Tiverton, Barnstaple, Taunton, and Exeter working together about 500, chiefly 8 qr. machines, entered into this restriction, not only without stock, but with large orders for France on hand at relatively high prices. This is explained by the fact, that the twist machines then at work on plain nets in France were 8 qr. The 12 qr. nets therefore, if smuggled in, would have been detected by their width, so the contraband trade was confined to 8 qr., which enhanced their relative price in Nottingham. The makers of them, however, gave their authority to their agents without hesitation, to bind them to the restricted hours, and they were duly adhered to. It is worth notice, that so great had been the demoralization amongst some of the families of the workpeople by the relay or shift system, and continual nightwork, that several machine owners in the west resolved, when this temporary restriction ceased, that though the long hours

were resumed in the midland district, they would not return to them again.

The amount of capital engaged in the machinery thus restricted, was about one million sterling; returning when at work in finished goods, three millions sterling a year, and employing with more or less constancy about 150,000 workpeople. The committee sat weekly, and held six large public meetings, at a total expence of £390. This is believed to be a solitary instance of such an almost unanimous delegation of authority and power on the part of the proprietors of so large an amount of machinery and capital, wielded so long, and relinquished with such a prompt and decided resolution. It is interesting to remark also, that all those who signed, except seven, were originally working artizans; as were all those in the trade who did not sign, except one, Mr. Fisher. Some, but not many frames, were hired from those that remained of the outside owners who crowded into the business in 1823-4-5. Where did the rest obtain the one million of money wherewith to become possessed of 3300 frames, and the additional credit and capital necessary for materials to work them? The whole was the result of individual labour, skill, economy, and foresight, exercised for the most part during ten or twelve years. While too many, pressed by the after exigencies of the trade, have returned to their original position of workers in machines, which they for a time owned, the remainder with their successors have built up the goodly trade edifice that we now behold.

During about nine months of the year 1829, fortnightly meetings were held of the agents for the sale of power plain nets, at which lists of prices for them were agreed upon. So long as they could be obtained, these lists regulated sales, but as trade declined by accessions to the machinery employed and return for the most part to long hours, the impossibility of controlling prices by any such compact was manifest, and the meetings ceased. Since that time, though often proposed in periods of difficulty, the plan has only once been actually resorted to. This was in 1835, and as it immediately preceded a sudden increase in demand, its

operation was highly beneficial. There has, on the part of some of the principal machine owners, ever since prevailed practical disunion in relation to fixed rates of prices.

The author's connection with the public operations of the bobbin net trade in 1828-9, gave him facilities for drawing up with considerable accuracy an account of its then extent; he therefore published such a document in 1831. Some of the more important facts will serve as a basis of comparison with future similar enumerations.

The Manchester and Nottingham spinners and doublers' capital, employed in 35 factories containing 682,000 spindles and in stocks of wool and yarn, was calculated to amount to £935,000. The bobbin net trade had in 22 factories 1000 power machines; also 3500 hand machines, stocks unwrought, wrought and in embroiderers and finishers' hands, valued at £1,375,000. At this time the number of people employed was about as follows: Manchester spinning and Nottingham doubling, 13,000; power net making, 3000; in hand machines, 5000; 4000 winders; 6000 menders; 30,000 pearlers, drawers, and finishers; and embroiderers wholly or partly employed in addition to domestic work, about 150,000. This surprising number was spread round Nottingham for fifty miles and in London, Devon, Somerset, Norfolk, Scotland and Ireland. The work being given out at centres near their homes by persons competent for that purpose, embroiderers' wages and profits thereon were this year about £1,525,000. The diminution in the amount of embroidery, required a few years later, caused corresponding distress. At this time the larger part of the produce of the machinery, consisting of 1350 hand levers; 100 hand rotaries; 1300 hand circulars; 750 hand traverse warp and pushers; and 1000 power machines; 4500 in all;—was disposed of in Nottingham by fifteen agents for factories, and about 200 persons who carried their employers goods daily from one finishing warehouse to another for sale. The first cost of cotton wool, almost the only raw material used, was £120,000; the ultimate returns amounted to £3,417,700; passing through the hands of about 70 plain and 70 embroidering houses. An excessive and most rapid reduction had taken place in wages, for the amount had fallen 6*s.* a-week in the last two years; and men did not get now more than 18*s.* and youths 10*s.* a-week, working the difficult and ponderous twist net machine by hand. Winders, 2*s.* to 5*s.*; menders, 4*s.* to 8*s.*; embroiderers working long hours, children 1*s.* to 3*s.*; women, best hands, 5*s.* to 8*s.*—reduced in 1833 to 1*s.* to 1*s.* 6*d.* and 3*s.* to 4*s.* 6*d.* respectively.

If the reader carefully notices the fact that the 4500 machines could not have cost the handicraft owners less than £300 to £500 each, many of them much more, the following list is a most interesting one, as creditable as it is, at least to the author's mind, melancholy, from the after position to which the small owners have been reduced: seven hundred owned 1 machine each; two hundred and twenty-six,

2; one hundred and eighty-one, 3; ninety-six, 4; forty, 5; twenty-one, 6; seventeen, 7; nineteen, 8; seventeen, 9; twelve, 10; eight, 11; six, 12; five, 13; five, 14; four, 16; and twenty-five owned respectively 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 32, 33, 35, 36, 37, 50, 60, 68, 70, 75, 95, 105 and 206. The total number of owners was 1382. It will afterwards be seen how rapidly the small owners were absorbed into the ranks of the journeymen, or disappeared from the trade. The principal cause was their falling into the error of putting too much of their acquired capital into machinery, to their distress and ruin as manufacturers, when the overload of stocks on all sides forbade prudent finishing houses to buy, and the payments for wages and materials compelled sales not only of goods, but eventually of the machines themselves at whatever loss.

The movements in the machinery of the trade, from 1824 to 1833, were thus important and significant.

In 1828, machines had begun again to be constructed; continued to increase in 1829; more so in 1830; chiefly of 8 qr. rotary; in 1831 many 10 qr. rotary; and again in 1832; and still more in 1833, and of increased widths. So that, notwithstanding the great number that had been sold as old iron, the total number which had become 4500 in 1831, had swelled out to 5000 machines in 1833. These consisted of—

Hand Levers, 5 and 6 qr., 500; 7 qr., 200; 8 qr., 300; 10 qr., 300; 12 qr., 50; 16 qr., 30; 20 qr., 20; . .	1400
Hand rotary, 10 qr., 100; 12 qr., 300; . . .	400
Hand circular, 5 and 6 qr., 100; 7 qr., 300; 8 qr., 400; 9 qr., 100; 10 qr., 300; 12 qr., 150;	1350
Hand traverse, pusher, and straight bolt averaging 5 qr.;	750
Hand machines	3900
Power, 5, 6 and 7 qr., 90; 8 qr., 350; 10 qr., 280; 12 qr., 350; 16 qr., 30;	1100
Total machines	5000

The embroidery was reduced two-thirds and the hands one-third. The total returns of the English bobbin net trade were lessened since 1831 at least one million sterling.

There had been publicly offered for sale from 1824 to 1832, 1843 machines, being 740 Levers, 418 circulars, 173 rotary, 512 pushers, &c., during which time certainly one-third at least of all the machinery in the trade changed hands. Machines of greater widths were constantly sought after in the midland district; while in the west of England the makers of bobbin net were wisely contented with 8 qr. to 12 qr. widths. Levers 6 qr. now sold for £30; 8 qr. £50; circulars the same; 8, 8 qr., 11 points which cost £5000 in 1825, sold for £300, and five other 8 qr. sold for £20 altogether; 6 qr. pushers which cost in 1825 £350, sold for £30, and traverse warps for £3 a machine. Rotary 8 qr. sold for £100; 12 qr. £180. The despair in 1834 of ever again making narrow and slow machines valuable, led to the breaking up in that year of between 5 and 600. Many were thrown piecemeal from the windows of the upper rooms in which they had been employed into the street below, not being thought

worth the trouble of carrying down stairs, though they had cost several hundreds of pounds each. A list is in the author's hands of machines thus broken up, which cost £2,000,000 but a few years before, and many of which were still in fair working condition. One of the Nottingham street cries then was "Old rags, bones, and twist (bobbin net) machines to sell;" and numbers thus found their way to the scrap heap. By 1835 however, constructors had found uses for many such despised frames, adapting them to produce very valuable articles, so that they had risen tenfold in value; not a few Levers and traverse warps, previously producing articles selling at 4*d.* a rack, were by a trifling outlay, made to produce at a slight advance in cost, articles which sold currently for several years at 3*s.* to 4*s.* a rack. Machines worth prior to alteration £10 each, after £50 had been expended in alterations to adapt them to make some new imitation of a pillow lace pattern or ground, have repaid the outlay the first month, and put £1000 a year profit into the pocket of the owner. For a time therefore but few more frames were broken up. Nevertheless the body of machinery was found in 1836, when an exact account was again taken of it by the author, to be much lessened in numbers, though partially compensated in production by their greater width. They had fallen from 5000 to 3800. But the most striking change was in the number and classes of owners as indicated by the machines each owner held. In 1831 there were 1382 owners, in 1836, only 837. Of these three hundred and two now owned 1 machine each, in 1831, 700; now two hundred and three owned 2; one hundred and two, 3; sixty-two, 4; forty-eight, 5; twenty-one, 6; fifteen, 7; thirteen, 8; fourteen, 9; six, 10; seven, 11; six, 12; ten, 12 to 20; nine, 20 to 30; six, 30 to 40; five, 40 to 50; two, 60; one each 70, 80, 100, 120, 170, and one, 200 machines. Thus more than five hundred owners of 1, 2, and 3 machines each, had disappeared; principally owners of the 400 narrow pushers, traverse warps, and Levers', and 800 narrow circulars, that had been withdrawn from the trade since 1833.

The change in the kinds of goods produced in these two eventful transition years was from plain almost entirely; 200 frames in 1833 only making fancies out of 5000; but in 1836, 1000 out of 3800. This is an important fact, shewing the tendency of the scientific skill at work to be now rapidly taking its only safe direction; and which before another twenty-five years had elapsed put an entirely new face upon this manufacture, by the general use of the Jacquard and other consequent improvements, in making fancy goods.

There were in 1836 at work,

	152 traverse warp,	165 pushers,	317
1293 rotaries making plain,	247 quillings,	47 fancies	1587
116 circulars making plain,	114 quillings,	188 fancies	418
16 Levers' making plain,	761 quillings,	448 fancies	1225
1425	1122	683	3547

And about 253 standing or not enumerated. Total at work 3547. Gross total, 3800.

In 1836 there were in Nottingham and its vicinity 372 machines making plain net, 1006 quillings, and 784 fancies, altogether 2162; in Leicestershire and Derbyshire 399 plain, 86 quillings, and 113 fancies; altogether 598; in the west of England and Isle of Wight, 654 plain, 30 quillings, and 103 fancies, altogether 787. There were therefore then 1425 making plain net, 1122 quillings, and 1000 fancies machines. The widest and quickest frames now made 30,000 meshes a minute. In 1835-6 it was stated in the report, on good grounds "that by the change in the employment of machines to make fancy work, in consequence of the pressure on the prices of plain goods and the application of Jacquard and other apparatus acting similarly on machinery, 1000 machines were raised in those years from the price of old iron (£2 to £10 each) to the value of £50 to £100 each, and 1500 to 2000 of the best hands were employed on them at an advance of 50 to 100 per cent. in their wages; adding also to the returns of these machines alone £300,000 per annum. Altogether a fresh and marked impulse was given to ingenuity and effort throughout every department of the manufacture. The raw materials consumed in 1836, cost £210,000; the final returns were computed to be about £2,212,000. Of this sum only about £350,000 was paid for English embroidery. The changes then beginning in the kinds and locality of employment, ensuing on the putting in pattern by the machine instead of by the hands of the lace runners, and which has never since ceased its operation, rendered it impossible to give any near approach to the numbers actually employed on either the new kinds of work or the old. The revolution has been almost complete throughout the whole process. Of the entire production of this trade, about one-half was exported in 1836, instead of three-fourths as in 1832. The number of persons employed in selling the rough production to finishers has much lessened. The finishing houses, 114 in number, now passed about half their goods through London to their ultimate destination.

Several incidents occurred from time to time publicly indicative of the fluctuations of the bobbin net trade. The desire broke out into action repeatedly for some years upon each access of trade stagnation, for the regulation by committees of the working hours of the trade, or of some branch specially affected. Thus, in 1831, a stint to eight hours daily labour was nominally agreed upon, but after a fortnight's trial ceased; the journeymen declined for a time to return to more than twelve hours' labour, and resolved to form a Lace-maker's Union. In 1832, a short stint was carried into effect by the conjoint efforts of masters and workmen. The government was also memorialised by the committee with an expression of earnest desire for *reciprocal* free trade with France. The injurious effects of many and conflicting patent rights was also

a topic now beginning to engage considerable attention in the trade. Another stint was attempted ineffectually of the Nottingham bobbin net frames, though persevered in at Loughborough for some weeks. The journeymen put forth a 'regulated' list of wages, amounting to 100 per cent. advance. This being refused, some windows were broken at Carrington.

It was thought that the interests of the local staple and other trades might be advanced by opening a hosiery, lace, and yarn exchange, in connection with a corn exchange, and the establishment of a chamber of commerce. These ideas have been in succession carried into effect. Another memorial, signed by 2500 persons, was presented to government, stating their increasing desire for the admission of English lace into France, and that of France into England, on a reciprocal basis or entire mutual freedom. To which the minister replied, "the government desired reciprocity, but could not force it." Dr. Bowring was then negociating on this subject, and expressed his belief that the free import into France of our lace would be ceded in twelve months from that time. The trade was so depressed as seriously to distress the workmen, many of whom did not earn through 1834 more than 8*s.* a-week. They earnestly pressed upon Sir John Hobhouse, M.P. for Nottingham, a bill "for regulating wages by the decisions of a Board composed of selected masters and men, and making a scale thus agreed upon, binding on the trade upon its receiving the signature of a magistrate." This plan he declined to sanction. These proposals for legislation in respect to the consideration and adjustment of questions as to wages and trade matters, led the author to make a translated *Analysis of the Laws and Constitution of the French Conseils des Prud' hommes*, which was published in 1834. How far and in what manner courts of arbitration, whether constituted legally or on a purely voluntary basis, can be made to work efficiently and satisfactorily for both parties, in adverse as well as prosperous states of trade, is still one of the great questions, social and commercial, of the day; the solution of which would almost seem more distant than ever. Measured by the grave differences between em-

ployers and employed, its magnitude and importance cannot be too highly estimated, and in proportion we hail with pleasure the amount of success attendant upon the operation of the hosiery board of conciliation of which we shall give an account in a future chapter.

In the distress of 1834 the owners of the 1100 quilling machines stinted their time, raised a fund of £2000, and maintained their prices. The like was attempted amongst the plain net owners, but without success. The reason for not assenting given by one great maker, was that "small makers lowered prices by their necessities, and ought to be driven out." Next year, however, 1835, a stint of hours took place, including the machines of the house just referred to, and the regulation of prices was carried out for two months; 1300 plain net frames worked only eight hours a-day, when a sudden revival of demand set all fully to work again.

The chamber of commerce, lately established, memorialised the Board of Trade upon the occasion of great distress amongst English lace embroiderers, which it was averred arose from the facility with which foreign embroidered goods were imported by smuggling into England. Ample proof was offered, shewing that the charge by smugglers into England was 5 to 7 per cent. only; while, by the superior vigilance and activity of the French officers of customs, the charge on their frontier was 50 per cent. for similar goods. The question was a very unpalatable one to Mr. J. D. Hume, Secretary at the Board. He spoke to the members of Parliament who introduced the deputation, of "this dab of Nottingham lace standing in the way of more important interests;" which drew from Mr. Heathcoat the remark "that it employed a capital of two millions, and gave work to probably 150,000 hands, making a return of three millions annually, therefore was not to be altogether frowned upon"—a statement more than confirmed by Mr. James Fisher then present, and rendered effective by Mr. J. E. Denison declaring "if the matter were not taken in hand by the customs authorities, he should feel it his duty to mention it in the House." Mr. Dean, chairman of the custom board, was surprised at the facts—placed beyond doubt by the

invoiced charges being produced—and he took steps to set the business in a more satisfactory position for a time. In 1837, the general money panic and pressure bore with especial weight upon the hosiery and lace business of Leicester, Derby, and Nottingham. At the latter place a subscription of £5000 was raised to assist the poor; parochial assessments were made, varying from 7*s.* 6*d.* to 12*s.* 6*d.* in the pound, and two thousand houses were untenanted; private benevolence was also exercised in a most effective manner. In October, only one-fourth of the machinery in either staple trade was employed, and that only working half time. The quilling machines were entirely stopped. Many heavy failures took place, and the chamber of commerce was broken up. An endeavour to get a general cessation of working of the machinery of the trades was not responded to; it being evident that even occasional employment of limited amount was of importance, when every fifth family was pauperised. Any orders that could be obtained must be executed without delay. At the "relief" meetings held in this disastrous year, the question was much discussed, "whether, as reciprocity in our trading with foreign nations appeared to be unattainable, the interests of employers and employed would not be best secured by a return to high protective duties and the adoption of a scale of remuneration for labour more adequately compensative to the artizans when in employment." The opinions of the workpeople were strongly in favour of this view of the matter. Amongst employers there was greater diversity.

The author, considering it the more practical way of meeting it, and endeavouring to forecast the future, took that occasion to propose—as means of securing in due time results highly beneficial to the trades of Nottingham and its sister towns—the establishment of schools of design; collections of models, patterns, and drawings; an alternate annual exhibition of the productions of the three counties; the adoption of measures for securing inventors' and trades' rights respectively, together with other measures, whereby the taste of fancy designers and the fabrics from our looms might be

improved; and then—while making machine-wrought hosiery and lace more and more worthy of approval by the leaders of fashion—taking well considered steps to bring them with effect under their notice, and that of the general mass of consumers.

Articles advocating these views—and especially pointing out the impossibility of safely depending for the employment of the vast body of lace machinery, upon the continued demand for plain net; and asserting that its real ground of permanency was in the production of close imitations of pillow lace—were inserted from his pen, at short intervals, for some years in the local press.

With reference to mechanical improvements since 1820 in the manufacture of lace, the following additional modifications of the double-tier circular machines have been made:

Jackson and Henson, of Worcester, in 1824, introduced the fluted rolling lockers moving carriages, having corresponding teeth. The lockers turned both ways by a segment. The movements are exceedingly swift in this frame.

In 1825, William Harvey improved the working of the machine by making the combs work more steadily. Other modifications of this excellent working mechanician will be noticed as they occurred. No one understood bobbin net machinery better than Harvey, and his personal qualities caused him to be highly respected. He died at Carrington a few years ago in humble, but comfortable circumstances.

William Shepherd, in 1831, constructed a single locker circular comb machine for making breadths, using a back plate riding on back combs and cut in long nicks. The plate pressing sideways on breadth carriages, prevented their advancing in the traverse motion and thus divided the net. At the time, this plan was a step in advance.

In 1832, Allcock, of Worcester, patented No. 6343, a rolling locker frame having two outward rollers, acting by a double segment, and made to move more slowly than the inner rollers, avoiding overshooting the carriages.

Joseph Litchfield, of Nottingham, produced spotting on a circular comb frame, by letting the carriages remain on both bolts and making spots by drawing spotting carriages by extra back and front pushers, and having only the usual point bars. By the action Fisher *v.* Dewick, this was decided to be an infringement on Sneath's spotting patent.

The pearl on the edge of machine-made laces had been stitched on by the needle with great care and expense, until about 1827 or 1828, when Marmaduke Miller, of New Basford, produced a good imitation of cushion-made pearl upon narrow edgings. This was

the first instance of success in regard to this important and difficult, though at first sight, seemingly minor part of a breadth of narrow lace. This was effected by him on the pusher machine, and having a bullet-hole on the edge of it, required the finish of a thick thread with the needle. Its introduction to the trade required some time and effort, but was brought about by Mr. W. B. Carter, and the demand soon became general. Levers' and circulars were soon put on to add a pearl, which, though not so lacy in structure, was of a more perfect loop-head. This improvement led the way to greater widths and much superior patterns. The inner sides of lace open works are now pearled on the machine.

In 1832, Mr. Miller arranged the pusher so as to work thick threads in various devices by using extra guides, operated upon by eccentric wheels; thus pusher tattings were produced.

This clever mechanician has not confined his abilities to lace machinery. He and his family, though brought up amongst the noisy machinery of these trades, have been thoroughly musical for at least three generations.

About 1836, one Davis, a workman, aided by others, arranged a machine—

By breaking out a part of the main guides and attaching others to a separate bar so as to take their place working it by a wheel, and thus interwove threads making cloth work taping on the edges of quilling nets.

This assisted to open the way to further ornamenting lace, by using the chain wheel in various ways.

A patent, No. 6412, was taken out in 1833, by J. and F. Smith, of Nottingham, for making quillings from circular machines.

In this the carriages had upper nebs moved by catch bars and under nebs acted upon by double lockers, using pickers to select dividing carriages. This plan was long worked at Chesterfield.

In 1836, No. 7219, and in 1845, No. 8362, patents for chains operating on bars, were taken out by the same parties.

About this time, Cook, of Loughborough, put together a machine, the carriages in which were propelled by two fluted rollers. It could not make breadths. Nothing more seems to be known of it than that from its speed, actual or proposed, it was called "the high-flyer."

Though some expected this plan would supersede all others, on Mr. Paget quitting the lace business it was laid aside finally.

Harvey made on circular bolt, in 1837, wire-ground having arched shaped meshes using four guide bars. And in 1839 he invented—

An apparatus for making silk figured laces, by putting in threads which could be withdrawn, thus leaving large holes which were afterwards filled up by the needle with thread imitations of fish-nets.

The plan, on which he employed four machines (his wife doing the needlework) was used for a time, but died with Harvey.

Thomas Alcock, of Claines, near Worcester, took out a patent in 1836, No. 7032, so multifarious in its objects and plans as to fill one hundred and eighty-three closely printed pages with the specification, and to require thirty-one sheets of drawings, mostly of the largest size, filled as closely as possible with illustrations. Sheets, No. 27 and 28, containing the front and back views of this "improved Levers' spotting machine," are commended to the examination of any one curious as to intricate inventions; being another surprising example of what self-taught mechanicians have constructed thirty years ago, in this wonderful department of genius and skill.

This patent, Alcock states to be partly for improvements on inventions patented by him in 1832 and 1835; applicable to traverse warp machines; to making spots on traverse warp fluted rollers rotaries; to producing spots on Levers straight down net, called Mechlin spotted net; also an improvement of Henson and Jackson's fluted roller circulars by using 14-point comb, and 7-point guides and points; and in single-tier fashion, producing spots &c.; also making spots on double-tier machines making straight down net. He further specifies an imitation of Valenciennes hand made lace, being a four-sided twisted mesh of two threads not traversed and ornamented with spots made on a Levers' machine, also the same mesh and spotting made on a fluted roller frame working single-tier; also the same working double-tier. He goes on to specify spots made on circular bolt traverse net in such manner that 'figure of eight' weavings of pairs of warp threads should form the spots, and the like manner of forming spots on the single-tier Levers' machine; this specially by the use of bullet hole apparatus, particularly that kind of 'turn again' combs patented by and known as Sumner's patent machinery. Finally he describes fluted roller machinery to be worked with single-tier combs

and bobbin carriages by two fluted rollers and comb-bars so disposed as to produce other fabrics than bobbin net, in the nature of weavings, tapes, or ribands of cloth work texture.

This specification includes a description of eleven distinct modifications of bobbin net machinery, in each of the three principal classes or combinations of them all.

In 1835, there were about 1100 machines employed in making cotton bobbin net in breadths. These were called 'quillings' or 'plaitings,' because used quilled or plaited about the head and shoulders. The demand for them was very much reduced for some years by a device adopted at this period of difficulty in the lace trade with a view to lessened cost and underselling, on the part of one or two engaged in this branch, whose cupidity jeopardised for a long time the character and consumption of the article. The process adopted was simple enough. The size of the mesh can be made nearly regular throughout the whole of the piece by adjustment from time to time of certain wheels in the machine. Without this, the increasing size of the work roller will cause the size of the holes to increase, till at the last end the piece will be more open in quality to a marked degree. Breadths are put up for sale in cards heavily pressed and banded; to undo which, before arriving at the retail counter, would spoil the sale. They are therefore bought on the faith placed in the seller. At that time these exceptional parties caused the goods to be made in this irregular way, and unjustly put them up with fine faces at top and bottom of the cards, the insides being of coarser qualities.

An attempt to introduce the like plan was made, in regard to plain wide cotton nets: but was effectually put down by the trade as soon as known. The fact and its results on the cotton quilling demand, are given here as a noteworthy example of the power of wrong doing on the part of even a single individual in the first instance, to influence demand and injure a trade. Under the sometimes excessive competition in business, too much care and determination cannot be exercised in any trade to keep up the soundness and real quality of the articles forming the staple of its productions.

An account of the proceedings taken by the lace manufacturers of Nottingham for the purpose of rendering effective the laws against the export of their machinery, will close this chapter; bringing our narrative of events transpiring in the trade, down to 1835-6—the period of its greatest depression previous to the close of the year 1866.

The large increase known to have taken place in the introduction of English bobbin net machinery into France, and its rapid transfer after the breaking down of the restriction of working hours, in 1829, led to the appointment of a committee in 1832, and the holding several public meetings of the trade with a view to take measures to prevent the continuance of the export of machines, and consequent increase in foreign competition. Long existing Acts of Parliament had prohibited the export of machinery of various kinds; as that of William III., 1695, which fined exporters of knitting machines in a penalty of £200, and punished them with twelve months' imprisonment; and its extension in 1718 to all other kinds of machinery used in silk, cotton, and linen manufactures, adding a penalty of £500 on persons seducing artificers to leave the kingdom. These acts were, during the following sixty-six years, confirmed; and in 1785 they were extended to include engines, tools, and utensils used in constructing machinery.

After the conclusion of the long and expensive war in 1815, the heavy burthens of which were mainly sustained by the profits realized by the employment of greatly improved labour-saving machines, there was gradually manifested a disposition to relax in the vigilant and strict execution of these laws. Licenses to export machinery were granted on exceptional pleas without enquiry; and artizans transferred themselves with their skilled training to foreign countries: that part of the law which forbade their emigration, after a parliamentary enquiry, being repealed in 1825. The committee sat again next year, and recommended the repeal of the rest of the statute, which the House of Commons at that time declined to do. The practice of licensing became more common, and countenanced the decreasing

vigilance of the custom officers in regard to this (to them) difficult and obnoxious duty, while it gradually made way for the practical carrying out of the cherished theory, that there is no difference in principle, and ought to be none in practice, between free trade in goods, and freedom to export our machinery and the tool making machines also. The bold and unscrupulous way in which this contraband trade was carried on after the cessation of the bobbin net patent monopoly, at length caused public opinion and feeling in the midland counties to take a more decided form. The meetings above spoken of appointed two permanent committees: a secret committee, to ascertain the removal of machines with their intended destinations, and to take measures for their seizure if going abroad, the members of which committee should be guaranteed from legal consequences: and a financial committee to receive, manage, and pay funds subscribed for this purpose. Within a month every principal house in the trade signified their adhesion, as did the body of journeymen also. It was at this time, that Gravener Henson drew up a memorial to the Lords of the Treasury, signed by the owners of more than 3000 machines and 4000 workmen on this important and difficult subject; which for fair statement of argument, skill in handling, diligent research, and nervous diction, would bear fair comparison with any document presented to the minister of the day. A solicitor of eminence was appointed. Mr. Heathcoat, Sir John Hobhouse, Sir Ronald Ferguson, Mr. John E. Denison, and other members of Parliament, gave their aid in applications to government, by whom these deputations were civilly but very coldly received. Besides the machinery, for the export of which treasury licenses were obtained, to nearly every shipping port round the island, parts of machines were sent; if seized, they were sold at the price of materials, because useless there for anything else; but when got abroad, were rejoined to the other parts, so making complete machines. A general notice was given at these ports, of the illegal nature of these shipments, and government was pressed to carry out the law against them by its own officers;

it was evident that local bodies had neither means nor power equal to the task. Nevertheless, the committee sought to strengthen their influence upon the authorities by a union with the manufacturers of Birmingham, Manchester, Leeds, Leicester, &c., which was but faintly accorded.

In the summer of 1832, Mr. William Morley, a partner with Mr. John Boden in the large bobbin net manufactory at Derby, being upon a tour in France and Belgium, obtained the best insight in his power into the amount of similar machinery at work in those parts. He stated the results of his enquiries thus: Calais 700, Cambray 400, Lisle 170, Douay 200, St. Quentin 150, and 380 in other places; making a total of 2000 machines. This summary was sufficiently important to further direct the attention of the trade to machine exportation. A machine was seized in 1834, but given up to the intending exporter by the Crown. Several others which were seized, were in like manner given up at the out ports, "proof of intention to export" being laid upon the informer and those who made the seizures. The Board of Trade declined to sanction any seizure five miles from a port. Upon which an application was made for a bill, to more effectually stop the export of machinery. The funds of the committee were now exhausted; they retired from further active opposition, but continued to watch events. Exportation of machines to France, Germany, and Russia, immediately recommenced on a large scale, £5000 worth lay at one time at a single wharf in London, and the execution of an order for £2000 more waited for models and drawings of every process then in course of preparation.

In January, 1835, an action was instituted by a Mr. Faber against G. Henson, for the illegal seizure of a machine in 1833, which the Crown had restored to Faber on submitting to his acquittal. The plaintiff was probably supported in prosecuting Henson by a body of persons interested abroad, either in machinery or in its transit by fraud. The attorney general was retained by him. Henson had adhered strictly to his instructions; it had been seized by the excise; he had

afterwards identified it. The few members of the secret committee, his employers, shrunk from the responsibility both individually (for the committee had expended its funds) and as representing the trade. The trial was put off by the plaintiff on frivolous grounds three times; we, though not of the five, furnished Henson with funds, that his cause might not be lost for lack of means, and so "the town gaol be his lot." At length, on June 23rd, 1835, "having fought a hundred trade battles at home and elsewhere," he determined to conduct his defence himself, and without any friend present, he took his seat in court, with books and papers, "to do that for others, which," he says, in a letter addressed to us the day before, "I am afraid few men would do for me, namely, protect them from the consequences of their own acts." This he must have the credit of doing, and in a most skilful and determined manner. The real object of the plaintiff was, to get hold of the undertaking given by the secret committee to hold him harmless in his proceedings carried on by their directions. This he resisted, supported by the sympathy of the bar; and after long and powerful argument, Lord Abinger said "he would be no party to bringing fresh suits" (*i.e.* against the members of the secret committee, who were men worth shooting at); "indeed, if they got the instructions, they would have to prove malicious intention. They had better take a non-suit"—a suggestion which was acquiesced in to the satisfaction apparently of most present. This result relieved the secret committee from their disagreeable position. But with the meed of admiration for this self-denying act, then and always expressed by the author, Henson had to rest content. It was his only repayment; except the fund of enjoyment derived from his triumph over the chief law officer of the Crown. Some may read these lines, who will feel that he did not deserve *all* the disparagement that has been cast upon his name.

A committee of the House of Commons sat in 1841, upon an enquiry into the exportation of machinery. At the request of a public meeting held in Nottingham, three gentlemen went up to give evidence against it.

In the next session the laws forbidding it were entirely repealed.

In 1836, there were 1863 machines for making twist lace in Nottingham and its suburbs. By 1840, 80 of these had been exported, besides 143 new insides; 485 had also been broken up, and 50 new machines had been built meanwhile at Nottingham.

CHAPTER XXIV.

THE JACQUARD FANCY LACE MANUFACTURE.

A NEW developement of the bobbin net lace trade has taken place since 1835, by the general application of pierced bars and the use of the Jacquard apparatus on the principle of individual selection of threads in fancy machines. The era of ornamenting lace in the process of making upon the frame has now been fully ushered in. The results are new, striking, and of the utmost importance. All articles from the narrow lace edging to the two yard wide store curtain requiring many thousands of cards to complete the design, are now as familiarized to our draughtsmen, mechanicians, and workpeople, as they were unanticipated by them forty years ago, or as to taste, workmanship, and beauty by the purchasers of lace goods only twenty years since.

The local School of Art and Design has been far more effective in promoting knowledge of the principles which govern taste in the choice of drawings, with a view to their successful application in the peculiar tissues of lace, than was once thought possible. It is but comparatively a few years since the idea was first broached in the press of Nottingham, that such an institution was absolutely necessary to secure the interests of the lace trade and of the town. The artizans of the district are not now, in respect of appreciation of the beauty of a pattern, like the same class of men they then were. Considering the difficulties inherent in a tissue composed of interstices large and small, of fine and heavy cloth work often uniting to produce effect by thick threads surrounding or veining a pattern, many of the floral and arabic styles now familiar to the designers in the larger establishments (in several of which an expence of £1000 a-year is incurred), will bear comparison as to light, shade,

contour, and effect with the elaborate works of the oldest schools in manufacturing art. In this respect the trade is placed on a surer basis than it was before.

It has been seen that *plain* bobbin net is made by the to and fro movements of the carriages and their bobbin threads, together with the lateral motions of the various sets of threads, whether warp or bobbin. Figured or fancy net is produced by the like movements; only instead of being of the whole of each set, and constantly similar in their operation, in making fancy nets, some are stationary, some pass between the warp threads, some are shifted laterally to the extent of one mesh, some to the distance of two, three, or more meshes; some to the right, some to the left; the warp threads too, instead of being separated into two divisions only, are separated into many, each of which is susceptible of the lateral movement independently of the others. It is by modifications of these lateral movements that all the numerous varieties of machine made lace are produced; such as cloth work or fining, open mesh work or bullet hole, thick threads surrounding or veining flowers or leaves, besides the great number of different meshes, blonde, Mechlin, Brussels, Valenciennes and others. A great portion of the present complexity of the machine, as contradistinguished from its previously simplified condition for making plain net merely, is due to the mechanism by which these lateral movements are produced. If the warp threads be placed in several divisions, each moving to the right or left independently of the other, and if the bobbin threads are similarly classed in several divisions, each moving without reference to the others; it follows that an almost infinite variety of movements may be brought about, and it is not difficult to see that these movements must govern the manner in which the bobbin threads twist round the warp threads, as well as how the different systems and sizes of warp threads are made to enter into the outline and body of the pattern required.

When the movements of the systems, into which the warp and bobbin threads are divided, are intended to be regular and constant, and of the whole of each set, then they are produced by the eccentric surfaces

of wheels operating directly on the bars controlling each class or set. But when the movements are to be irregular and arbitrary, as in fancy and ornamented lace, then it is by means of bars attached to springs or levers placed at the ends of the machine, that the various sets of warp threads, whether those sets be fifty or five hundred, are made to move laterally; each bar being of steel and as long as the machine is wide; and each pierced with holes answering exactly to the particular threads in the pattern, which are, by being passed through these holes, to be guided by the bars to take the place assigned to them in the formation of the pattern. The levers or springs which pull or push the bars to or from the end of the machine, were themselves selected formerly by nobs on wheels or cylinders with irregular surfaces, but are now almost universally by a Jacquard apparatus. This may consist of a four, five, or six-sided roller; each side being perforated with as many holes as there are moveable pins or levers placed in a frame above the rolling cylinder. A number of oblong pieces of cardboard, from fifty to five hundred it may be, are connected together in an endless chain, and so arranged as to size, that when one of the cards is laid on one side of the cylinder, and the latter is made to revolve, the whole series will be brought successively in contact with the cylinder, each one lying temporarily on the flat upper side. Every card is pierced with holes varying in number and position, according to the pattern of the lace to be produced, but never more in number than the pins or levers above; and these holes are so cut as to coincide exactly with those of the cylinder. The cylinder has an up-and-down motion given to it on the presentation of the face of each fresh card, bringing it in contact with the pins, so that wherever a hole occurs in the card, it permits the pin opposite to it to penetrate into the cylinder; but where a blank occurs, by the card not being perforated opposite to a particular pin, the pin cannot enter the cylinder, but is driven upwards. As the pins or levers act on the bars that move the threads in the machine, when any of the pins are driven upwards, some bars of the thread apparatus are moved laterally; the disposition of the holes in the

cards determining the order and number of shiftings of the threads. The number of cards employed depends on the number of successive movements requisite to form one complete pattern. In a store curtain, ten or twelve thousand cards may be required. The arbitrary selection of bobbin threads is brought about by acting upon the angular or raised parts on the surface of carriages by instruments called, from the duty they perform—pushers, stumps, selectors, &c., and so moving some carriages while others rest; or causing them to remain inactive, while the others are in motion. By these operations, brought about from below or above the combs, the power of the machine to diversify the course of the threads is evidently greatly increased. This kind of selection may be brought about by various mechanical arrangements; often a second Jacquard apparatus from the back of the machine is employed. Notwithstanding the great width of the machine—its complexity and intricacy, as well as the diversity and delicacy of the work to be performed—the construction and adjustment is so solid and exact, as to render the ordinary operation safe. So long as the machinery works steadily and correctly, the workman may be a mere spectator; but he must be a vigilant one. His eye must ever and anon pass from side to side of his machine, noticing the thousands of threads, bobbins, carriages, points, and guides, passing in rapid motion before him. Soft, ill twisted, lumpy cotton yarns spoil his work while they stop his progress. An ill tied knot in winding may cut down threads, which if unseen may lead to damage that may cost the man days, and the employer pounds, to repair. An irregular warp of mingled fine and coarse silk, and which if unevenly reeled is almost certain to be foul also, will sometimes take three months to work off, requiring intense labour and care, instead of running smoothly to a finish in as many weeks. In the case of the silk net generally made, but especially in very light or irregular weights, the eyesight is much and prejudicially affected. In factories of modern construction, warmth, ventilation, and an atmosphere free from dust have been secured. The health of the workpeople employed in machine lace

making is on the whole satisfactory; and if the practice of working by shifts in the night were discontinued, it would be superior to that in most other trades. In the manufacture of plain nets, the employment of the people is regular, except in some occasional times of difficulty, when the trade has accumulated very heavy stocks. Under such circumstances, a general reduction has taken place for a time in the number of hours the machinery has been worked. But latterly the owners of factories cease working or stint the whole or any of their machines without consulting any one. This is entirely the case in the fancy business, and is frequently adopted as to a single machine. The workmen also lose time on a change of pattern; which, in the case of those engaged in the Levers and warp lace branches, frequently causes a lengthened, and to the masters as well as man, an expensive delay.

Amongst the earliest and most ingenious, though not most successful pioneers of this great advance, Mr. Draper was as energetic and sanguine as any. Two patents, having together a most important bearing in this respect on the interests and progress of the manufacture of imitations of real lace on bobbin net machines, were taken out by "Samuel Draper, of Whitemoor, Nottingham," in his own name only, though assisted with capital by Mr. John Hind, in the years 1834, No. 6683, and 1835, No. 6907.

In the first patent he adopted a plan of traversing the bobbin threads every time they were passed through the warp threads, and thus made a handsome linen fabric. In this machine he used extra bars for the selecting of threads, and operated upon them by means of an organ barrel.

Next year he patented the other machine, in which there were two sets of bobbins, arranged one over the other; the upper set being in *single-tier* steeple top carriages, the lower set being in *double-tier*, also steeple top carriages; the bottom set traversed having three comb-bars, the back comb-bars being divided into two bars. He traversed with the bottom set, and at first selected by using an organ barrel: but, it is said, seeing a Jacquard in the Lowther Arcade, London, he adapted it to the lace machine. The bottom tier of carriages were governed by drivers placed between the bolts, which selected any required carriage. By letting these bottom carriages remain stationary, or traversing them every motion, he made net, large open works, or cloth work. Between the two sets of carriages was placed a point bar, riding between the front bolts, having two

lengths of points in front operated upon by the cards of the Jacquard cylinder; when the holes in the latter are not covered by the card, the pins enter and the carriages remain at rest; but when the holes are covered, the carriages are taken backwards, and are either traversed or are passed through the combs. The points enter the back line of threads, and then shog to the front line; when the points are all entered, it then shogs to make the net. It is withdrawn and entered each time the carriages pass, the upper carriages making the net as in the straight bolt and in organ barrel machines.

Many excellent patterns were made on this machine, but it did not work safely, and was very expensive in its construction. Although Mr. Heathcoat made a special visit to inspect it at Whitemoor, and so far took an interest in it as to purchase some right in the patent, and also had Draper at Tiverton for a considerable time, conducting some mechanical improvements there, yet the plan was finally abandoned. The outlay by Mr. Hind was many thousands of pounds. Mr. Heathcoat gained nothing by it.

It has been stated above, that the accidental sight of a Jacquard led to its substitution by Draper for the organ barrel, as the means of selecting threads. Mr. Andrew Wilkie, a table linen manufacturer, came from Dunfermline, in Scotland, and settling in Nottingham, quitted his former business, and entering into that of making bobbin net, became possessed of four or five bobbin net machines. He ultimately co-operated in the experiments of Draper; and conjointly with Hind, it is said, supplied money for taking out the patents. Having been accustomed to the use of the Jacquard in his former manufacture, on the failure of the organ barrel, (he always asserted) it was at *his* suggestion, that a Jacquard apparatus was tried and eventually answered. His son therefore claims this honour on his father's behalf; who (he says) expended £650, a sum which came to him through his wife, and the whole of his machinery. Wilkie died soon after in humble circumstances.

Draper's second patent was for the application of perforated substances to lace machinery. In taking out this patent, he said "he had in view the government or control of the individual threads across the machine, and this also on each of the several principles of the bobbin net machine." The plans for this purpose he

laid before Mr. Carpmael. The working out the patent on each of the classes of the machines would have been so expensive, and the time so long to have put them on, that it was considered one would be enough to secure to the patentee the exclusive use of the principle for the whole. Draper, having to consult the views and arrangements of others, was delayed and thwarted in getting the machinery to work, by circumstances beyond his own control. The plans became known. It was nevertheless understood that tribute was to be paid him by those who used machinery constructed on the principle of his patent. He did not deny the merit (if the idea were not surreptitiously derived from his own) of Mr. Deverill's mode of application to and control of the guide bars; or of any other that had been devised having that effect, by the operation of the Jacquard apparatus. He claimed the merit of shewing, that the application of Jacquard pierced cards, or of the use of nogs or raised points or surfaces acting on bars, was practicable.

The first scarf made by Draper on the Jacquarded bobbin net machine, is in the collection at South Kensington museum. The fellow to it, in the state it came from the machine, was retained by himself.

Draper took out a patent in 1837, No. 7491, for using the Jacquard cards on warp machinery—

Including the plan of using a double number of threads, either for the purpose of increasing the firmness of the tissue produced by carrying the threads over the adjoining needles, and then returning them to the original needles—one of the two threads being carried at the same moment to the right hand, the other to the left—thus making a crossing and then back again. No traverse was obtained by this method, beyond carrying threads five needles to produce open work. It was the first step, however, towards obtaining one. Champollier worked this plan in France, but without success. In 1840 Draper patented, No. 8635, a further modification of his Jacquard application.

This great problem of how most simply, easily, inexpensively, and perfectly, an entire control might be obtained over every thread at work in a machine—so as that without going backwards (which it is evident those threads which are mechanically operated upon cannot do) they should be as completely under command as those in the fingers of a pillow workwoman—

was thus grappled with by Draper. He had not solved it when faith and money on the part of others failed him. The expence incurred had been very great, the means had been advanced very liberally; but unhappily for the ingenious constructor, he could not perfect his results in time to prevent their exhaustion. Nevertheless, these elaborate and diversified combinations of machinery—having for their object what, the moment his attempts were seen, appeared to be certain of ultimate accomplishment—were the true germs of that which has since been done by his successors, with great profit to themselves, and to both the bobbin net and warp trades.

It has been the opinion of some, who from their experience in machinery were quite able to form a sound one, that had Draper persevered in using the straight bolt in 1831 (whereon he made lace all pattern with no meshes, traversing every time the carriages passed through the longitudinal threads) he would have produced an article in quality equal to pillow lace. On the straight bolt the carriages will remain at rest while the open work is made. In the circular, which he then adopted, he had to overcome the difficulty of the carriages gravitating to the centre.

In 1838, Draper devised a very curious plan, a description of which has been reserved for this place, as it contained a method of producing an imitation of real Alençon blonde laces, partly by machinery and partly by hand:—

> A silk net wholly untraversed was made on a Levers' frame, from which net the warp threads could be drawn out at pleasure. On another Levers' machine was made a solid web of quillings, about ten holes wide. A warp and extra beam was used for draw threads. The carriages were divided, and while in front and back catch bar, a warp thread was shot in the full breadth, thus making a solid fabric. These two fabrics were used thus: The linen tissue was inserted on the lace, and was drawn by the needle in any required form, as it was capable of being lessened in width by drawing the warp threads together. The net threads were then extracted, and the cloth work shewed as if woven in, giving the appearance of the Normandy blonde cushion lace.

But the needle-work made the cost higher than the real article. After three years expence upon it,

Mr. Hind, Draper's partner in these experiments, declined to make further outlay, and it was given up.

The last modification made by Draper may be described as one by which warp threads were passed through beads holding them in a row of points; the card being raised lifted the beads on which the warp threads fell into another set of points, which were moved by an eccentric wheel, different from that operating on the main guide bar points.

This ingenious mechanician was living at Nottingham in 1856, we regret to say in deep poverty.

Six years after Draper's second patent, *i.e.* in 1841, Hooton Deverill took out a patent, No. 8955, which was alleged to be the first really successful application of the Jacquard apparatus to bars from the end of the bobbin net machine. This raised at once, and in a serious form threatening much litigation, the question of what in this respect were the rights acquired under Draper's patent just described. The staple trades, to the history of which these pages are devoted, have been the arena of more patents and discussions consequent upon them, than perhaps any other in the whole range of British manufactures. The one now before the reader is, even amongst them, remarkable for the points raised, diverse opinions given upon them, and the results ultimately arrived at. Some further details may therefore throw light on the operation of patents generally, when added to the other facts spread over these accounts of mechanical inventions. These will be best given by citing the questions put and the answers to them by Mr. Carpmael in November, 1841, and by Mr. Newton in June, 1842. To avoid tedious repetitions, it must be understood, that where not otherwise stated, the reference is always to bobbin net machinery. To Mr. Carpmael—

"*Question.* *A* and *B* have invented a mode of working *guide bars* by Jacquard cards. Is it new to work these guide bars by Jacquard cards; and if new, can the patentees claim generally to work guide bars and by Jacquard cards, or must they confine their claim to the mode they have invented?

"*Answer.* I have read specification of Draper's patent, 1835; of Crofts, 1836; White's, 1837; Crofts, March, 1840; Draper, 1840; and of Crofts, November, 1840, which I think are the only patents in which it is proposed to employ Jacquard cards in working bobbin net machinery; and am of opinion that if *A* and *B* are the first to invent means of applying Jacquard cards to working these guide

bars, they may safely claim the application of Jacquard cards to work these guide bars, and not confine themselves to the exact details by which that application is made. This mode of claiming invention was fully supported in Winter *v.* Wells; Morgan *v.* Seaward; Elliott *v.* Ashton, and in some other cases. On the other hand, if *A* and *B* have been anticipated by others in using Jacquard cards to work these guide bars, then they must only claim the peculiar mode by which they have applied them; and it appears to me, that *A* and *B* will be obliged to confine their claim of invention to their novel mode of application, and must not claim the application, generally, of Jacquard cards to work these guide bars. For in the specification of Crofts, 1840, there is fully described the application of Jacquard cards to work these guide bars.

"*Question.* There having before been several patents which relate to the use of Jacquard cards regulating the working of the *threads* in twist lace machinery, would guide bars worked by Jacquard cards be an infringement of any of those patents? if so, which of them? In what position do these various patents legally stand in relation to each other? *A* and *B*, wishing fully to understand their own position in respect to others, and the position of the trade in respect of their patent; and, generally, in the use of Jacquard machinery in combination with that of twist lace.

"*Answer.* Draper, in specification of patent, 1835, claims to be the first to combine the properties of the Jacquard loom with twist lace machinery, and describes a mode by which it is carried into effect, such mode being so arranged as to act on the bobbin threads. But the patentee states he does not confine himself thereto; as any or every of the threads may be governed by Jacquard cards. And he concludes his specification by claiming the *combining* Jacquard machinery with twist lace machinery, thereby producing a compound machine having the capacity or combined character of the two machines. Under this specification, I can have no doubt that the using of Jacquard cards and machinery to work the guide bars of twist lace machines, would be an infringement of Draper's patent. And this opinion is based on cases already cited, besides Fisher *v.* Dewick, and Russell *v.* Cowley, (in the last case the defendants were working according to a patent obtained by them) and many others; particularly the first lace case ever tried, Bovill *v.* Moore, wherein it was held that traverse warp bobbin net machines were an infringement of Heathcoat's patent; and in fact, till Heathcoat's patent expired, every twist lace machine, if used without license, would have been held an infringement of that patent. The court considered that Heathcoat, having been the first who caused one system of threads to traverse and twist round another system of threads by machinery producing bobbin net, his patent was not to be judged of by the details by which that end was accomplished. At the same time, the traverse warp patent would have been good in law, had the patentee confined his claim of invention to traversing warp, thereby obtaining breadths of lace and other results, which were then very valuable. But the patentee could not have used the traverse warp machinery, without license from Heathcoat so long as his patent was unexpired.

"I am also of opinion that Crofts' mode, described in patent of 1836, of selecting bobbin threads by Jacquard cards and machinery,

if used without license would be an infringement of Draper's patent. Also White's mode, patented 1837, of working warp threads by separate intercepting instruments; worked by Jacquard cards and machinery. Also Crofts' mode of governing working threads, patented September, 1840, would each be infringements of Draper's patent. Also, that if Draper's mode, described in patent of 1840, of working warp threads by Jacquard card machinery be practised by any other person without a license, it would be an infringement. Also, that if the mode of using Jacquard cards to work warp threads described in Crofts' patent, November, 1840, be put to work without license under Draper's patent of 1835, that patent would be infringed.

"I give no opinion of the position of *A* and *B's* patent in respect of this patent without knowing the particulars of *A* and *B's* invention. In conclusion, I am of opinion that as Crofts, White, and *A* and *B* have obtained patents for peculiar modes of applying Jacquard machinery, and cards to the working threads of twist lace machinery, Draper could not use without license under their patents, their respective *modes* for the application of Jacquard cards and machinery.

"W. Carpmael, Lincoln's Inn, 1841."

The following opinion on the validity of the patent granted to Draper in 1835, was given by Mr. Newton, 1842:—

"In the specification of Draper's patent, in 1835, for 'improvements in producing plain or ornamental weavings,' the patentee describes a mode of adapting a Jacquard to work certain Levers' drivers for selecting certain of the bobbin carriages applicable for producing patterns in lace; and he states at the end of this specification that he claims 'combining the properties of Jacquard looms with bobbin net machinery, whereby the cards or other perforated substances are caused to select any and every of the threads of the latter machinery, and cause some to be laid or woven into plain or ornamental weavings; and whereby a machine so constructed will partake of the capabilities of both these descriptions of machinery, and enable the workmen to produce a greater variety of weavings, plain or ornamental, than can be produced from either uncombined.' There seem to be several important legal objections to the validity of this patent, taking its title and specification together. But without entering into these, the main feature of enquiry is: Can the patentee maintain the exclusive use of the properties of the Jacquard applied to lace machinery, however modified, supposing all other parts of the patents sound? My opinion is that he *cannot;* and that, for the following reasons: 1st. The properties of the Jacquard are in the *Dawson's wheels*, long known and applied to lace machinery. Also in the *chime barrel*, the adaptation of which, to a lace machine, is the subject of his previous patent of 1834. 2nd. Plain and ornamental weavings have been produced before by various kinds of mechanism in lace machinery, and in ordinary weaving looms by the Jacquard. Therefore the novelty or improvement, if any, must be in the means of applying that old contrivance, the Jacquard, to a lace machine. For even supposing the product or quality of work produced 'plain or ornamental weavings' to be new, which is not the fact; still the

invention is not the 'weavings,' but the means of producing them. This must involve the '*modus operandi*' by which such production is obtained, not the thing produced. This is certainly by combining the properties of Jacquard looms with bobbin net machinery, whereby 'certain improvements are produced, and certain results take place.' But how is this to be done? Does the simple direction, that the properties of two old things are to be combined, give to the uninitiated sufficient information to enable him to effect the production sought? Certainly not. Therefore the patentee has very properly shewn the construction of apparatus whereby the object may be effected; and this apparatus I take to be the matter of invention, for which alone the patent could be granted. The claim of combining the properties of Jacquard looms with bobbin net machinery is absurd, without a specific means of enabling the combination to work so as to produce the fabric required. The patentee has set out one mode, and that is, his invention; all other modes of making the combination available, must be the subjects of distinct inventions; for any other mechanical contrivance is not obvious from the specification. The patentee not having pointed out any leading feature, or general mechanical agent, whereby the Jacquard can be adapted to the various constructions of lace making machines. If it could be shewn that the essential matter of Draper's invention are the levers *B*, acting upon certain of the bobbin carriages with their projecting arms *A*, operated upon by the Jacquard (which, I think, cannot be made to appear from the words of the patentee's claim); then it would follow, according to my views of the patent laws, and the practice of the courts, that all other modes, forms, and combinations of mechanism for connecting the principles of a Jacquard with a bobbin net lace machine, are open to the inventive world to modify and adapt as they please.

"Draper has a subsequent patent 'for certain improvements for producing ornamental lace or weavings,' November, 1837, which is the adaptation of the Jacquard to warp machinery, and much in the same way as before adapted to bobbin net machinery; and I think his general claim in this case may be answered by the same argument as before.

"If it were necessary to say more on the main point above considered, I would cite the opinions of several judges on this question: 'If a specification be such, that men of common understanding can comprehend it to make the thing by it, it is sufficient; but it must be such that they may be able to make the thing by the specification, and not by any new inventions or additions of their own.' 'A specification is insufficient if a man of ingenuity be required to supply its defects. If sensible men who know something of the business and mechanics in general cannot by the specification make the thing invented, it is not so described as to support the patent.' Query. Does the statement made in Draper's specification shew the mode or furnish the means of adapting the Jacquard properties to a Levers, a pusher, or any other differently constructed bobbon net machine? I think not. It only shews a mode of holding back and locking certain of the bobbins in a Morley's rotary. It does not appear to contemplate any movements of the bars as in Deverill's or Boot and King's. I will again quote one of the Judges: 'Articles of specification which denote intention only, and do not state the thing to

which it is to be applied, will not entitle a patentee to maintain an action for a breach of those articles; for he cannot anticipate the protection before he is entitled to it by practical accomplishment.'

"In conclusion I would add, that I think Draper must have felt this was the proper interpretation of the law as to inventions. For in September, 1840, he obtained another patent for 'improvements in the manufacture of ornamental twist lace and looped fabrics' by the adaptation of the Jacquard to work warp threads in a particular way; although in his patent of 1837 he has the wholesale claim of 'the application of the system of selection by Jacquard cards to warp machinery or warp lace machinery for the purpose of governing and controlling the order in which threads are lapped on needles or worked in looped lace or looped woven fabrics.'

"(*Signed*) W. Newton."

It is probable that these widely differing opinions were given in answer to questions arising from the very important modifications of Hooton Deverill, when they were transferred to Messrs. Biddle and Birkin. In the face of the diversity and doubt thus opened up, these gentlemen practically and with praiseworthy public spirit, relinquished their patent rights, and by emancipating the trade, conferred the greatest benefit upon it at a period of unequalled depression in the plain branch, and when its freedom of action in the fancy department was most ardently desired.

Mr. Richard Birkin was born at Belper in 1805. He was the son of poor parents. His father was a calico weaver, and his first ideas of mechanism and labour were connected with the shuttle and loom. He had but a limited opportunity of gaining knowledge at school, having been employed early in life in Messrs. Strutt's mill, where he laboured until he was seventeen years of age. During these years, his evenings were spent at home in reading, drawing, or contriving objects of utility, which were sources of improvement and pleasure to himself, and not unfrequently of profit to his family. In 1822, he removed to New Basford, a suburban village to Nottingham, then containing thirty houses or so. A relative named Blatherwick, hitherto a framesmith at Nottingham, was just entering into the manufacture of lace in this village, and under his instructions, R. Birkin learned to work one class of bobbin net machines; losing no time and endeavouring to become practically master of the several other kinds

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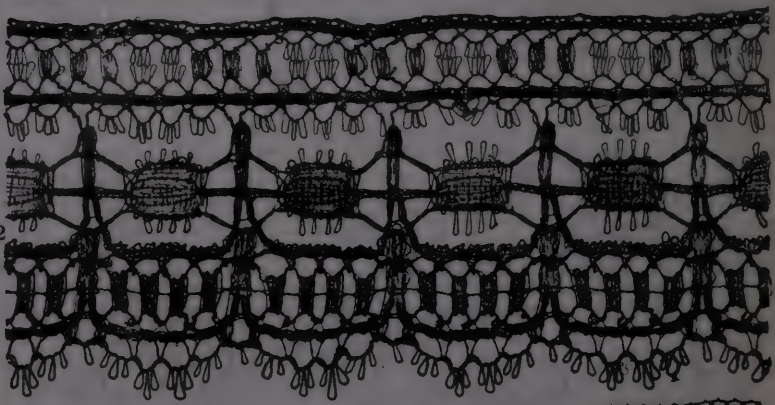

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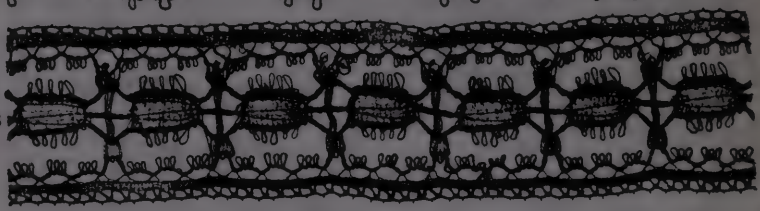

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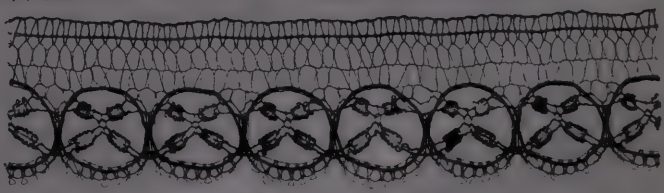

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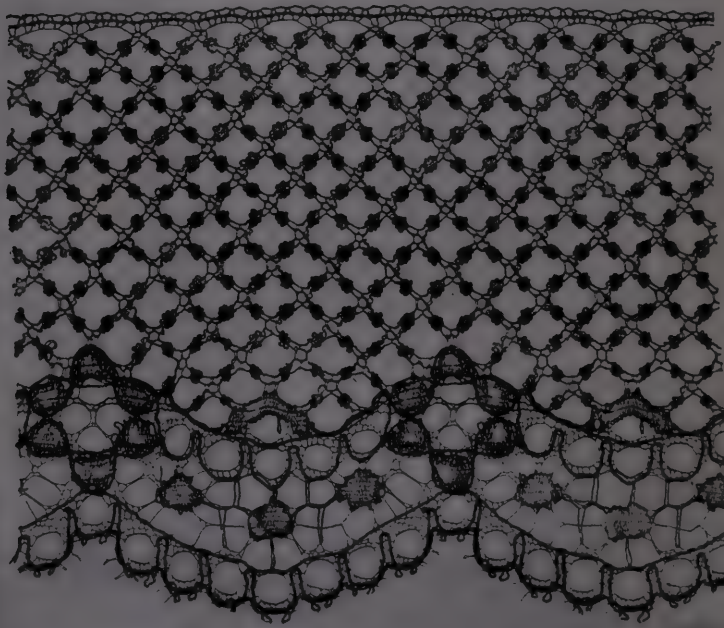

of construction. These machines were all of them originally very costly, complicated, slow, and difficult to work, as has been already seen. Yet they were each realizing £20 to £30 weekly to not a few of the owners, and wages of from £5 to £10 a week to diligent and clever workmen. Birkin husbanded both time and money; seizing the opportunity afforded by this epoch of frenzied excitement, when the wondrous rush of capital flowed into the trade, he took it at the flood; and the tide, dexterously managed, led him on very rapidly to fortune. During the next few years, his aid and advice on mechanical matters were sought by most of the machine owners in that neighbourhood. In 1826, his employer Mr. Biddle offered him an advantageous partnership. It was accepted, and the connexion continued twenty-one years. At the end of that time his partner retired with an ample fortune, leaving Mr. Birkin the buildings and machinery necessary to the carrying on of the now large concern. By this time New Basford had become a town of 3000 inhabitants or more. It was a new place, a new people, and with a new occupation. In it were now many persons who had risen from humble occupations to be wealthy employers; and some even corporators and magistrates. The principal of these, Mr. Birkin, has shewn no ordinary skill, shrewdness, and intelligence, combined with great perseverance and energy, in the pursuit of the manufacturing and commercial success with which his efforts have been crowned. Having always been distinguished for his good taste and sound judgment in qualities and designs of lace goods, he was appointed juror on behalf of Nottingham for those articles in the International Exhibitions of 1851 and 1862. His comprehensive reports on those occasions will be made use of in our subsequent pages. He has left private business in the hands of one of his sons, and for some years devoted himself with much assiduity to municipal and magisterial duties, those of chief magistrate especially, to which has been recently added, that of a seat at the board of the Midland Railway directory.

Amongst those who have been engaged with the

Lever machines, perhaps no one has shown a more intimate knowledge of its capability of adaptation than Mr. Birkin. He was the first to arrange it so as to produce several classes of ornamentation of great importance, both in what they were in themselves, and in what they further pointed to as practicable.

In 1828, Mr. Birkin accomplished making a pearl edge on Levers' breadth laces. Before this the pearl was stitched on.

In 1836, he patented No. 7090, a method for producing spots and honeycombs without stoppages on the Levers' machine. He also devised a way to make ribbons of cloth work sideways on it, but did not prosecute the plan. Having comprehended the powers of this machine and how they might be rendered most effective, he has closely imitated the most important classes of real laces upon it. Such are imitation Valenciennes and woven edgings, silk Saxony edgings, black, coloured, white silk blonde, and other edgings. Mr. Hooton Deverill's patent, No. 8955, was bought by him; and the plan of working Jacquard cards, not to the bottom set of carriages only as Draper's did, but most usually applied to bars at the end of the Levers' machine, was perfected, and soon became general. By this great improvement a new development of the trade took place.

His confidence in the principle of producing first-class articles in quality and pattern has been well repaid. In 1845, he put upon a machine a pattern produced by Dawson's wheels, brought it out at 3*s.* 6*d.*, it has gradually been reduced to 9*d.*, and still pays a fair profit. The machine has made no other pattern. An edging was brought out fourteen years ago at 3*s.* 9*d.* The machine has made it ever since; it has fallen to 9*d.*, and is yet paying a good profit. Black silk laces with fining, thick threaded, scolloped, and to which Birkin added *perfect pearl edges*, only needed a thread to be drawn to separate each breadth in a state finished for the market. These were made of best twisted silk, and were calculated to wear well. Another manufacturer put in cotton warps, degraded the article, and ruined himself. From 1849 to 1851, R. Birkin altered

machines at a cost of £80 to £120 each, and was repaid the outlay in a few weeks, using mohair as a material for lace. He was the first to do so, either in England or France. "Lama" and "yak" are only other names for lace of somewhat similar materials.

John Woodhouse Bagley had one of the most singularly gifted mechanical minds that has ever been applied to the improvement of the bobbin net machine. By his adaptations of it, effecting the production of imitations of pillow lace of various and most intricate kinds, so close and perfect as almost to defy detection, and yet of chaste and elegant patterns, he proved his claim to stand in the first rank amongst those who have advanced the character and use of machine-wrought lace. (See Plate XV., Nos. 18, 19, 20, 21.)

Bagley's various productions were shewn in the Exhibition of 1851, and were highly praised both by jurors and visitors. Again, in that of 1855, at Paris, the articles he exhibited obtained for him a high eulogium, and the only silver medal awarded in the class to a *working* mechanician. Though from the ardour of his temperament—manifested in all that he did and said, whether in regard to mechanical, political, or any other subjects—he laid himself open to be misunderstood; yet those who are well informed as to the progress of this trade will accord to Mr. Bagley the meed of unqualified praise for the variety, ingenuity, and usefulness of his modifications of this machine. In his boyhood he received a very imperfect education, scarcely using a pen beyond occasionally appending a clumsy signature. But his mind and memory were clear and strong enough to dictate in nervous, though somewhat ungrammatical English, in the year 1856, a document filling thirty-two pages of folio manuscript. The substance only of this paper can of course be given, but so much must not be withheld from the reader, of a curious and interesting chapter in the history of lace inventors and their inventions. It is headed, "A few particulars of the various steps by which I progressed in machinery." The facts, so far as can be ascertained, seem to be truly given, being on the whole in accordance with notices of them gathered from the trade:—

"When I was about sixteen, I left shoe-making which I had been taught, it being then in a very distressed state; and, enquiring for work of Mr. Sansom a lace-maker, obtained it, he putting me into a straight bolt machine, in which I soon learnt to work. Having from a mere boy, helped my sister in all manner of platting and twisting, while she was engaged in making the first English Leghorn bonnets, I had gained complete mastery over the movements of threads, and readily saw how to get off the 'wrong twists' which was a frequent difficulty fallen into by the apprentice. I had very limited previous knowledge of the machine, or how to work it, and so had to get into the way of it as well as I could.

"After this, I worked for five years with Mr. James Smith, of Radford; and assisted him in getting the first circular machine put on with 'Grecian net.' Though receiving no wages for twenty weeks labour, it was not time ill spent, a large amount of information was gained, very valuable to me; nevertheless, I left him and went to shoe-making again; employed two journeymen, and was getting on very well. But I could not forget mechanical operations, so set to work and made a model of a 'twist' machine; and began to sell plans for making nets (meshes) to any one, feeling myself able to do anything of this kind that was wanted. Giving up shoe-making finally, I went to work for Mr. Morley; and offered to put him on with 'honeycomb' net, by putting into the machine ten or twelve bars. He laughed, and said 'more than four could not be got in.' The plan was submitted by me to Mr. William Crofts, at Mr. Fisher's, who expressed satisfaction with it. I was employed there on other work; till, finding a circular was putting on with turn agains, and open work without them, I left there. As there were till then no 'extra guide bars,' I determined to keep my plan to myself, and employed a smith to make these bars for me. A person named Peach having a small Levers' frame joined me; advancing £40, and giving me 25*s.* weekly, to receive half the profit of the plan, which at length was got to work. I advertised further plans of meshes for sale, and received a threat of an injunction from Fisher. Then some negociations took place; but Peach sold the plan to the bobbin net mart for £100; of which, though I had a claim also for £23 for wages, no part was paid to me. The mart charged £2 a piece to any one using the extra guide bars. At that time 'plain blondes' were much used; and these extra guides greatly facilitated their ornamentation. The demand for some years was very great for both my classes of goods; much wealth was gained in Nottingham by them, while I was occasioned inexpressible trouble, and all I received was abuse and slander. I resolved now to act on my own account. My father lent me £10, and my wife's father £10, with which an old 'circular' was bought; the smithing in it I got done on credit. During the time this machine was getting to work, my sufferings from hunger and those of my wife who was then suckling our first child, were intense; we were reduced to the deepest distress, so that for three months, we only ate meat once, and subsisted during several days upon water gruel without bread; my father-in-law on learning our state, assisted to keep us from starving, for which we were very thankful.

"The machine being completed and the first piece sold, Mr. Fisher

sent me a note, charging me with an infringement; but in conversation said 'we want you in our employ.' I engaged with him and continued there for several years; being employed in getting out new things, for which they obtained patents. My own machine above named, was worked by a man at my own house; and on shewing things made on it to my employers, was promised rewards, but did not receive them." (By an agreement, dated 13th November, 1838, made between Fisher and Bagley, all the inventions of the latter were to be paid for by Fisher giving him £100 for any one patented, and £100 more if Fisher put up four machines on the adopted plan).

"When I was specifying the traversed warp used on a circular machine, Mr. Carpmael's clerk gave me a bit (a quarter of an inch long and an inch wide) of Valenciennes lace, saying 'I think you can do it.' I took it home, shewed it my wife, and said 'I shall never go to sleep till I have made it.' Consequently, setting to work, I stuck to it till, to my surprise, my model and shirt were on fire; my wife then thought it was time I went to bed. I did not stay long there, for as I lay, I thought of the *double warp*; then said I, 'I have got it. I have got it!' I jumped out of bed, put up double warp threads, and before breakfast, had produced the mesh.

"On the holiday given upon the day of Queen Victoria's coronation, with the assistance of Mr. Cutts and my journeyman, I put my own machine on with this lace, shewed it to Mr. Fisher, and then to Mr. Crofts. Something handsome was promised me, and after some demur, I specified it. The patent was taken out in William Crofts' name, 1838, No. 7638. £100 was given me and one license, as 'two or three machines' it was said 'would stock the trade.' Soon after, I left Mr. Fisher's employ, contrary to his wish. My first piece of this plat lace, (*i.e.* from his own frame) was sold at £1. 15*s.* a rack; and was re-sold in small pieces, as samples, to 'twist masters.' The rest was disposed of to London shopkeepers chiefly. A large manufacturer handsomely gave me £20 for the mere remnants, for I could scarcely proceed for want of means.

"Mr. Pearson, of Calais, sought an interview with me at Derby, shewed me a bit of lace, asking 'if I knew anything of that.' I told him it was of my own making. He wished to buy the plan on fair terms, and paid me £150 down, to be made £500 when a frame was finished and patented; in six months an eight-qr. was at work and patented. From the bobbins being too tightly sprung it broke threads at first. I went over and remedied that, and the goods were then easily made. Pearson got £2 a rack for two years, without change of the pattern; the Paris buyer made a great sum—Mr. Keenan told me 'an independent fortune,' and the two journeymen to Pearson, each saved £700 out of his earnings. It was twelve months before a machine like it was got to work in Nottingham. The pattern was ticked round the cloth work, as it is now made in Nottingham. Mr. Fisher at one time had let sixty licenses at three guineas per week each; he himself at the same time having many machines at work on with the same, and putting others on as fast as he could. (This tribute would be £163. 16*s.* a-year, whatever the width of the machines. From other sources statements have been received that the tribute paid was £1. per inch per annum of the width of the machine, which is more probable.)

"I gave £300 for a *circular* machine, and put it with three others on with plat laces; but all were beaten by the superiority of *Levers'* for this work. My own license I let to another. I then spent £150 uselessly in an effort to put a *pusher* on with plat fancies. But I produced several other articles, which though they were of no advantage to me, have since been profitably worked by the trade.

"Mr. Dunnicliff now sought me out. He wished to become connected with me. I had a seventeen-qr. machine not working for want of means. I sold him half of it for £100 cash, which being paid, the machine was sent to be worked at Wild's factory; I having previously produced upon it muslin cloth work and ornaments. Crofts, Dunnicliff, and myself went to take out a patent, in 1844, No. 10,390, for this invention; though, until a specimen made on it was shewn by me at Carpmael's office, Crofts would not believe this ornamented lace could be made. Dunnicliff then persuaded me to put on machines with a substitute for light warp blondes at Page's, Carrington; by which he afterwards stated to me, he and his partners gained £1000 the first year. *I* did not get 40*s.* for doing it. I then put my old frame on with traversed net and looped fining. It answered for a time in the pusher demand, but soon ceased. Mr. Dunnicliff retired, under painful personal circumstances, from business for a time; and my patent operations were stopped. On my machine, I afterwards made *the first* black silk figured shawls, so far as I know. They were sold to Mr. Ball, with whom Dunnicliff now was become connected. Other machines were better adapted by width and speed for production than mine, and my workmen became dissatisfied; so I was thrown aside in this article. I now bought two pusher machines for £40; sold one at once for £50; and then put on the other with fancies, and sold it for £300. The old frames were smashed, and sold for old iron. I resolved to go to America.

"Before starting on that voyage, I took my wife and son to Paris. While there, I was shewn by Mr. Keenan, for the first time, Honiton sprigs; and learnt the prices at which they were sold. This caused me much study; but while walking from one end of the Boulevards to the other, I accomplished the making of them in my mind; and saw that on the same plan, Valenciennes edgings could be produced. Returning to Nottingham, I put on machines to make these edgings; the plan becoming soon known to two or three others, they wished to become connected with me in working it under a patent; one was taken out in 1850, No. 13,122, in the names of Dunnicliff and Bagley. At this time there began many difficulties among all the parties who were making these edgings and other things, as to their respective interests and rights under the patents for my inventions. No regular agreements were signed, nor licenses issued, nor accounts kept. One party protested against the claims of another. At one time I made money fast by my Valenciennes edgings, and began to manufacture Honiton sprigs; but it required more capital than I could command. A partnership, from which there was just ground to expect large profit to myself, and to embark in which I had declined good offers elsewhere, was dissolved; and I had to leave the business without any capital coming to me at all. I had forgotten to mention that, having bought a round hosiery knitting-frame in Paris in 1851, I devised a method of making ribbed work

from it, and shewed it to a house who patented the plan without my permission; upon putting in a caveat against it, a settlement by arbitration was effected. Another patent, No. 13,880, in 1851, was obtained for a method of making round knitting cord, found out by my son; the interest in this specification we sold for £50. A large machine owner was using my Valenciennes patent, but without paying me for it, although I had put on for him a machine with Mechlin spots without any reward. 'A man of straw like you,' he said, 'can do nothing by going to law with me,' and laughed at me.

"This is a brief outline of my history (1856), and of the treatment I have received. Many are enjoying wealth from my labours. I am in difficulty to know how to pay my way."

In this dilemma he was advised to place himself in the hands of a competent and independent party, who by knowledge of the value of his inventions and of business in general, might so direct his efforts as to secure adequate profits to himself from them.

He had all along been the victim of his own restless versatility of invention; together with inability to make a safe bargain on a fair estimate of the value of his inventions; and an aversion to keep strict accounts himself or to require others to do so; in all which respects he shared the characteristics of the great majority of his class. The demand for the superior kinds of goods, of which he had originated the manufacture, continued; the profits of the half-share of his last patent and which he received, increased; and it is pleasant to have to state, that from the time at which his narrative concludes, his position became more stable and his circumstances comfortable. He died in the year 1859, aged about fifty. His son, also a clever mechanician, after exhibiting their productions in the Exhibition of 1862, died of consumption. Their business is carried on at present by a son-in-law.

CHAPTER XXV.

THE BOBBIN NET MANUFACTURE. 1837 to 1866.

Affairs in the local trades in the midland district were very adversely affected by the commercial panic of 1837; that of lace suffered in an especial manner. Half the hosiery and more than half the lace machinery ceased being worked. Prices of materials fell one-half and sales of wrought goods were almost impossible. Some houses did not make an entry during a whole month. A relief fund in Nottingham maintained 4,400 stocking and lace makers, representing 22,000 souls out of 50,000 inhabitants, for several months, and the poor rates rose from £11,628 in 1836, to £21,139 in 1837, although the aid from private benevolence was unusually great. 1,155 houses were shut up out of 11,000 in the borough.

This depression continued for several following years, with short occasional fluctuations. In 1843, the prices of plain bobbin net were reduced to the lowest figure at which they have been ever sold, viz. 8-qr. $2\frac{1}{4}d.$, $2\frac{1}{2}d.$, $2\frac{3}{4}d.$ per rack for 10, 11, and 12 point, and 12-qr. $4d.$, $4\frac{1}{2}d.$ and $5d.$ for the same qualities. Three-fifths only of the lace frames were at work for fifteen months. The following anecdote will strikingly exemplify the alternations to which this plain net business has been subjected. It was during the period of great prosperity, that upon the occurrence of a fire that consumed the machinery of Messrs. Wheatley and Co., the principal plain lace manufacturers at Chard in Somersetshire, that house determined to replace it by the construction of seventy-two new 12-qr. machines of the most improved description, under the superintendance of Mr. Riste, an able mechanician, formerly a workman, then become a partner in the firm. So satisfactorily was this

performed, that though the loss by the fire was estimated at £40,000, it proved a permanent advantage to the proprietors; the new machinery working by steam, more than covered that large sum by the profits realized from its operations during the first year after it was got to work. On relating this fact in 1838, Mr. Riste stated, "that he had himself received for making a yard of net £1. 6*s*., which at the time he spoke, would be paid for by the sum of one farthing"—a reduction to one-fifteen hundredth part of the original cost of the labour necessary for its production.

Between 1844-5, the market was so overloaded with platted laces, that though a beautiful and sound article, the prices fell to one-fourth of what they had been previously sold for, and still were only sold with difficulty.—The 'registration of designs act' had been lately passed, and much benefit had been expected to result from its operation. But a case was brought before the magistrates in Nottingham this year, for alleged piracy of a warp pattern, in which the complainant was unsuccessful, and it has since practically fallen into desuetude. There are often inseparable difficulties in the way of proving either originality or piracy of patterns.—In 1845, the lace trade was overdone in all departments. Fisher had only twenty-five machines of all kinds at work, and a number of licenses for his patent plats were given up. The prices for all fancy goods fell greatly. Levers' edgings and laces were sold at 1*d*. and $\frac{3}{4}d$. a yard—some at the prices which the yarn cost of which they were made. There were numerous instances of small machine holders, to whom more than one cotton-yarn dealer had been accustomed to give eighteen to thirty-six months credit for materials to work up in the two or three machines they owned, who had thus been enabled to accumulate large quantities of fancy lace goods, often of inferior patterns. These were at length pushed into the market, and sold at a terrible sacrifice, which inevitably issued in transforming the owner at once into a twist hand again. Many of these machines were purchased for exportation, at exceedingly low rates. For instance, an 11-qr. $11\frac{1}{2}$ point Levers' Jacquarded with 160 bars, and which latter with altera-

tions, cost £350 putting in, sold for £26. Yet during these trying years, many fancy Levers' machines of from 16-qr. to 20-qr. in width, were built for the manufacture of Jacquard laces. In 1846, a public meeting was held of 2,000 lace hands, half of whom were partially employed, the other altogether out of work. They prayed the House of Commons to restrict the working time to sixteen hours, and two shifts a-day. This petition was also signed by 430 small machine owners; 27 of the larger owners petitioned against it; and the bill was negatived by about 130 to 50. All parties agreed, that the working hours of women and children should be restricted. This was succeeded by the formation of the existing bobbin net workman's union. It was agreed to pay 2*d.* to the local and 4*d.* to the national fund weekly; to receive weekly, if the wages be 16*s.*, 10*s.*, and if £1, 12*s.* 6*d.* a-week from the union when sick or out of work. The depression continued in the trade. A lot consisting of fifteen 8-qr., ten 10-qr., and one 12-qr., with 200 lb. of fine yarn, was sold altogether for £230.

The government school of design had been established some time, and was working very successfully. Appropriate patterns were gradually multiplied, and the business of designing for the lace trade was introduced.—Early in 1846, a deputation was sent by the body of lace manufacturers and merchants, to request government to make a representation to the Spanish authorities of the reciprocal benefit to each nation that would result from moderate duties being levied by the one on English lace, and by the other on Spanish wines. The question was mooted at Madrid, but nothing came of it.

The commercial panic that supervened almost universally in 1848, produced severe losses in the Nottingham lace trade, as well as in the hosiery business of the midland districts. The American markets had been overstocked with goods, in realising upon which great sacrifices were made. No regular sales of either hosiery or lace were made in the home markets from October, 1847, to April, 1848, and much distress was produced by hands being very partially employed. The demand

for lace gradually revived in 1849, when some articles began to be made on the Nottingham lace machinery, which had been imported till 1845 of the lower kinds from Saxony, and the more expensive ones from France. These were black silk ornamented shawls, scarfs, and flounces. Mechlin straight down plain cotton nets began to be much used after a time; the same article made of silk was very largely consumed, and has more or less continued in demand until 1866. This net was first made three twist, then double, and at last single twist only. By 1851, the principal Nottingham articles in machines fancies were cotton edgings, insertions, linen laces imitating white pillow goods, muslin edgings, and laces, platted, spotted, and other nets, imitating Valenciennes. Lace curtains, bed coverlids, and blinds, toilets, and d'oyleys, finished on the frame of excellent designs for superior furniture use, and at excessively low prices for the million, were after a time supplied in immense quantities. Some of those who have written disparagingly upon the subject of taste in lace, as seen in some classes of English goods, seem not to have taken into account, that we have to provide goods to suit the fixed unchanging taste of the Hindoo, the West Indian, or the South American markets. However it may differ from our own or that of the French, it cannot be forced. The same leaf or stripe or geometrical figure may be required year by year, to the great advantage of the manufacturer. For a similar reason, the window screen of lace for the cottage of the poor must have some design, some figure to enliven it, however imperfect the outline, or low the price.

After the Great Exhibition in 1851, there was a revival of demand for the three twist net of fine texture, suitable for the ground on which should be applied with the needle sprigs, braids, and flowers made at Brussels and Honiton on the pillow. Mr. Sewell had made this article for many years. Mr. William Gregory purchased the machinery of Mr. John Kendall, one of the former licensees, and, though not originally a mechanic, had by working at a lace machine become master of its construction and management, as proved by the excellence of these three twist fine nets, of which he has for some

years been a principal manufacturer, and thereby secured considerable pecuniary results. No doubt he gave strict attention to minute details in the management of his machinery and workpeople. What, however, he deemed of no small importance as aiding his progress, may be gathered from remarks made by him publicly after a dinner on his recent election into the municipal council:

"Mr. Gregory said he never denied his birth. He was not ashamed of having been a collier. He had also been a farm labourer for ten years; he thought if he had not been a good servant he should not have remained in the same place ten years. He always contrived to save money however, and when he left farming he returned to the colliery. He had even been a beer-house keeper, and his wife had worked in a stocking-frame. If she had not been an industrious and economic wife, he could not have succeeded as he had. He felt proud of his family, with whom he had been very happy; and he was glad to say he had a son sitting beside him who would make a much cleverer man than himself. He had his wife and family to thank for his success. Having striven hard to attain his present position," he concluded by saying, "some might be there who, by following his example and taking care of their money, would possibly attain a much higher place than he had done." (The business is now conducted by the son above referred to).

Amongst those who quitted the ranks of working men at lace machines, and who became employers of large bodies of workpeople, were the brothers Samuel and Jonathan Burton. They were originally frame-work-knitters and afterwards point net hands in Nottingham. We first saw them about 1828 employed in making bobbin net upon narrow frames in Broad Marsh. From thence they removed to the neighbourhood of Mount street. Afterwards, becoming connected with Mr. Sewell, they built and occupied large premises at Carrington, for the manufacture of plain net from circular machines of the best construction. The Messrs. Burtons accumulated capital rapidly; and after a few years Mr. Samuel Burton established himself in a separate factory at Sherwood, where after a short interval he died, leaving considerable wealth to his family. Mr. Jonathan Burton remaining behind, increased his machinery to the number of about seventy 16-qr. to 20-qr. in width. Besides making this outlay in buildings and machinery, he purchased a valuable landed estate in the neighbourhood. He died suddenly a few years ago. The management of

PLATE XVII.

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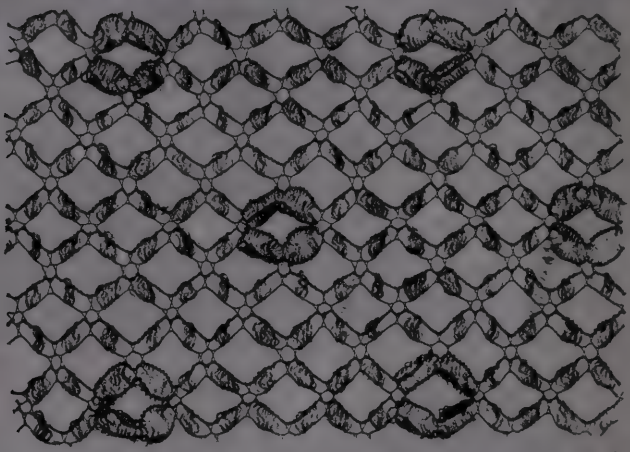

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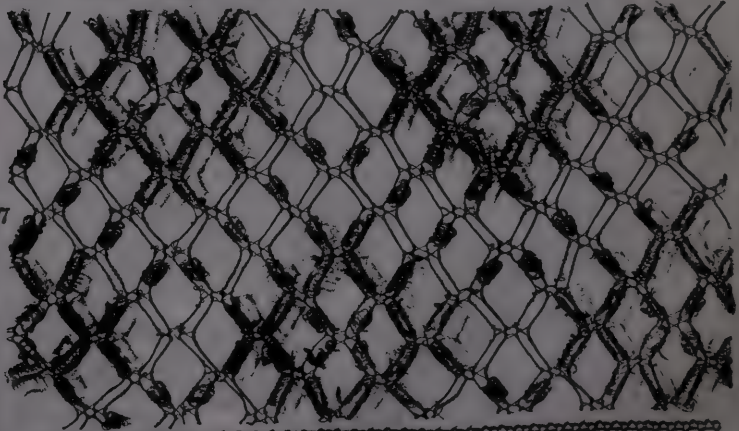

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A. COATER SC

his business was characterised by constant personal vigilance, and great decision upon emergencies; combined with such confidence in the accuracy of his calculations, and the soundness of his judgment of probable events, as led to the exercise of singular patience in waiting for results.—The Messrs. Burton, Mr. Gregory, and other similar instances of successful management which might have been adduced, shew that the inventive talent of this district, though it greatly preponderated, has been accompanied frequently by a large measure of administrative ability,—a fact probably not confined to our local artizans, and is of growing interest in connexion with the enquiry now occupying deservedly so large an amount of public attention as to the policy and practicability of conjoint interest of employers and employed in manufactures, and of the probable results of co-operation on the part of workmen amongst themselves.

In 1844, Mr. Alfred Butler made fancy open net and cloth work on circular machines—

By Jacquards operating on levers which pushed the carriages behind where required, traversing to make cloth, not traversing to make open work. The carriages were divided in the traverse, and the two tiers were kept apart, it is said, by using small carriages without tops but with nebs under them, by which both sets were driven by a peculiar kind of locker blade.

An invention appeared in 1846, produced upon circular machinery, by Mr. John Livesey, a draughtsman, of Lenton, called from the looped formation of the meshes and the threads not traversing, 'straight down' net; and it is upon this arrangement that curtain nets and curtains are principally made. The tissue is not solid or fast, and will not bear too much stress in wear; nevertheless cloth work of single, double, and three-fold texture can be introduced at pleasure; and intermixed with openworks, form elegant designs in the net work, by the application of Jacquard apparatus at the ends of the machine to one class of threads, and a separate one acting at the back upon another part of the threads, so as to produce the effects of light and shade in floral or geometric patterns. These are much admired for their beauty when hung up so as to intercept the light.

Livesey begun by using only one tier of carriages and bobbins. Where more warp threads were wanted in some parts for the pattern than in others, he supplied them from additional warp beams. Instead of the bobbin threads twisting with the separate warp threads, as in common bobbin net, one bobbin thread on this plan acts upon two warp threads, turn and turn about, which causes that the meshes united by one and the same bobbin thread, are produced in a vertical line. Hence its name.

This plan was not at first thoroughly successful; but by the consecutive assistance of Elsey, Sisling, and Cope, the proposed result was eventually more than realized.

They introduced the action of the Jacquard upon a second warp, serving for weft, placed behind the machine, wound on large bobbins as on the traverse warp plan. There are large carriages holding large bobbins, supplying the ordinary warp bobbin threads. These, by the action of a peculiarly formed spring, were kept at proper tension, and when slackened coiled back again aright. The ordinary bobbins and carriages serve for joining together the straight down ranks of meshes.

In 1851 there were 150, and in 1862, 300 of these machines at work in and near Nottingham.

They have chiefly been in the hands of Walker and Elsey, Robinson and Sisling, Wheatley and Co., and Cope and Ward. Each of these houses have made successive modifications in them, which have increased the power and excellence of the production, and at length seem to have firmly established the demand for these articles. The speed of the machines is such that a pair of curtains, each four yards long, may be produced on one machine in two hours. In the Exhibition of 1851, some 'store' curtains, each five yards long and two yards wide, consisting of one elaborate pattern only, were shewn, valued at £1. 10*s*. the pair. Each of these patterns required 12,000 to 15,000 cards to be used in the machine. The business in these goods is intermittent; during the season some tons weight of cotton curtains leave Nottingham weekly.

Of the latest improvements in curtain machines, one was patented by Messrs. Catford and Wheatley in 1861, No. 2507, for making the article with a traversed mesh, and consequently possessing greater durability than that formed of loops only. The greater cost of this ground must so enhance price as to affect the sale, it may be feared.

Another improvement was introduced by Messrs. Cope, Ward, and Cope, in 1860, No. 707, producing—

A new fabric in which the warp threads are united together, and pillars formed by looping them in substitution of bobbin threads. Needles are employed, each having an eye through which a looping thread passes. These needles are operated upon so as to take their threads between the warp threads, and to loop with them. The threads of these needles may be aided by hooks, and other instruments, in the movements given to the warp threads to effect the interlooping and tying together of the warp threads. Points and point bars, as well as bobbins and carriages with their combs, are dispensed with. Series of guides or interceptors, and traverse or extra threads, may be employed.

Mr. Cope being a clever mechanician, and having acquired a practically accurate knowledge of the bobbin net machine, had effected a modification of it, which he patented, No. 238, in 1858. Again, in 1860, his firm took out a further patent, No. 2855, with a view to simplify its action and increase its speed—

By means of taking from a crank pin on a rotary shaft, a lever to give a rocking motion thereto, and to connect with it another rocking shaft, whereby parallel motion is obtained; and thus there is imparted the required segmental motions and alternate rests to the back and front catch bars. Also, there is described an application of dividing instruments to act upon, and hold the warp threads between the guide bars or other selecting instruments for acting on these threads, and also on the under side of the carriages after each selection, and while they pass from back to front, or front to back, and thereby give time for a fresh selection of warp threads during their oscillation.

A further patent, No. 2098, was taken out in 1864, by Mr. Cope, for an improvement in bobbins and carriages.

John Livesey, the originator of the curtain net machinery, was so well acquainted with the various classes into which the lace manufacture had become subdivided, that he was enabled to take instruments from each for the purpose of effecting new combinations, and for these he obtained additional patents.

In 1851, No. 13,750, was for a mode of making articles resembling velvet and Brussels carpet ground; piled and cut, piled and embossed velvets, tapestry, or Berlin needle work; and lace with velvet figures, and internal pearls, spots, and ornaments. Also, having two or more piles to each carriage thread, and with a back and front ground, from between which the pile thread is drawn. Also, a mixed ground partly looped and partly woven, on which Berlin work stitches are

formed. Also, embroidered grounds with raised piled surfaces; and, finally, patterns in or on piled or cut piled, and in introducing more colours than were before practicable.

The productions here enumerated were of most diversified character and great beauty. The ingenuity displayed in the bobbin net machinery thus modified was highly creditable to the mind which devised and executed it.

The next year, 1852, S. Nicholls and E. Wroughton, mechanics, with J. Livesey, united in taking out a patent for several improvements in the circular hosiery knitting frame—

Into which they introduced warp and weft threads, and a break for stopping these machines. Also, for improved straight frames for plain and ribbed hosiery. Also, for an apparatus introducing weft threads in lace machinery, and making improved grounds thereby. Also, for improved instruments for making pile and other fabrics. And for making new fabrics, one part made at right angles to the other part; also fabrics made edgewise, and tied together at intervals. And, finally, improvements in making fringes and piled fabrics.

Some of the articles produced under this patent were ingeniously made and in good taste.

Livesey patented in 1852, No. 1139, for lace piled fabrics. In 1854, No. 1571 and No. 1748, the former for improvements in making laces, the latter in fringes from lace machinery. In 1855, No. 32 was for printing lace, and No. 182 for machinery. In 1857, No. 2997 was for further improvements in the machinery for making piled fabrics. His last patent was taken out in 1861, No. 2043, for methods of making lace embroidered articles, trimmings, &c.

This aptitude for and versatility of inventions evidence a great amount of mechanical power, but in Livesey it was more suggestive than practical; he indicated the way to important objects rather than pursued it so as to secure the beneficial results. Of these he obtained little beyond the needful supply of his daily wants. His mind seems to have been discursive, full of plans certain, as he averred, to bring large gains, but he lacked the energy and determination to work them fully out. Thus the greater part of life having passed without Livesey realising any pecuniary harvest from his inven-

tions, by a friendly contribution he was assisted to emigrate to Australia, where he is still living, it is hoped in comfortable circumstances.

Besides the modifications described more at large in connection with the names of other skilful inventors, the following were made during the epoch on which we have now entered, and are worthy of notice.

In 1841, Joseph Wragg, of Lenton, smith, assisted by Bertie—

> Used the cylinder and cards, but instead of holes they put on knobs of wood of different heights to act on guide bars, forcing them to greater distances than by compound levers, and thus got gimp threads round the flowered patterns, which had before been put in by the needle.

This was a great discovery, operating however to displace the labour of many lace embroiderers, and to overturn some important arrangements of the trade. The goods being nearly finished for the market on the machines, much labour, time, and capital, previously employed in giving them out all over the midland counties to be run or tamboured, were saved; but the hands were gradually thrown out of employment. This was not an unmitigated evil, for the labour was unhealthy, and of late years ill-paid for long hours and close application. Moreover, the demand for female labour has increased so rapidly in Nottingham, as to have absorbed a constant supply of such country hands within the last twenty-five years—a process which is likely to increase rather than otherwise.

An able mechanic, Whittle, of Nottingham, lessened the cost of operating by guide bars, by placing a distinct bolt for each, which was acted on by the cards.

In 1842, Brooks put double cylinders on Levers' machines to propel the guide bars, moving them both ways. The plan became generally used.

Clarke and Kerrey used, instead of cards, plates on which were knobs to be changed at will.—W. Henson, Worcester, proposed to improve the bobbin net machine, by using a set of middle points as a guide bar.

In 1842-3, C. Nickells took out three patents for introducing elastic thread or India-rubber strands into the productions of lace machinery. They were Nos.

9472, 9629, and 9735 respectively. No. 9290 was a patent taken out by William Catford, of Chard, for a double cylinder Jacquard. This was purchased by James Fisher.

Charles and John Thornton constructed a machine in 1842-3, in which long levers were made to operate on other levers which were controlled by the Jacquard, and all were moved by power.

In 1843, Polak, of Brussels, caused the Jacquard to act on wires, through which warp threads passed, and when drawn by the Jacquard, enabled the carriages required to pass on the other side of the warp threads, only two guide bars being used.

This year, Tansley and Marsh made imitation plat laces, using three warp to one bobbin thread. The platting was done by the three warps, the bobbins merely passing to and fro to hold them together, and prevent their unravelling.

In 1844, a patent, No. 10,163, was taken out by William Clarke, for making traverse ground ornamented lace, forming scollops on breadths by accumulating a series of warp and bobbin threads. It was understood not to have been a successful, though a very expensive effort, costing it is said £3000.

The same year he obtained another patent, No. 10,350, for scolloping on a Levers' frame, causing warp threads to gradually accumulate to form the scollop, and leaving the points, by extra points to take up the twist, and making a sewing thread connect the net and the scollop. Several other methods were used to make this scollop, for one of which, said to be superior to the patent one, £100 was given to the inventor.

In 1844, *John* Fisher, with Gibbons and Roe, as machinists, took out a patent, No. 10,424, for manufacturing ornamented lace. In 1845, they obtained another for four distinct purposes, No. 10,716.

1st. For making lace with scolloped edges by the use of moveable combs or bolts, so as to cause the carriages that make the edge, and the carriages that make the body of the breadth to which the edge is applied, for a time to work away from or differently spaced from, those of the body of the breadth of lace. These are single-tier Levers' carriages. 2nd. To govern the make of bars and gaiting them, so as to secure their perfectly geometric exactitude in movement, reckoning the spaces by (say) eighths of gaits or spaces within the compass of the apparatus. 3rd. Apparatus for

making warp fabrics by using two hook bars, and dispensing with the presser bar to simplify the machine. The machinery arranged according to this improvement, we prefer should have the warp beam placed above, and the guides for lapping the threads in a vertical position; the sinkers in a horizontal position, and stems of the hooks which perform the parts of the stems in the needles ordinarily used, in a vertical instead of horizontal position. 4th. An improvement on the patent, No. 10,424, by which instead of one bar, any number of bars may be placed in a frame and used for each description of instruments employed in producing the patterns, so that several rows of pattern may be produced at the same time. This patent has fourteen sheets of drawing appended to it.

No. 11,644 was for improvements in the fabrication of lace or weavings.

In 1857, Mr. John Fisher took out No. 2279, for making spots and finings simultaneously.

About this time, Mr. Waterhouse, of Chesterfield, had constructed a fourteen-point machine, the carriages in which were moved by rolling lockers. The intention was to imitate the real Brussels ground, which is formed by two warp and two bobbin threads composing the upright pillar, and a warp and a bobbin thread being twisted to form each of four sides of the mesh.

This machine could only traverse over two meshes, and, in consequence, the lace had a shady appearance. The open and cloth works were good imitations of the foreign lace, but though from so fine a guage, the ground looked rather coarse. Nevertheless, Her Majesty Queen Victoria, as well as the Dowager Queen Adelaide patronised its use, and it was commended in the *Times*.

Mechanics had not succeeded in traversing plat nets, made from fast warps, and it was suggested that the shaded appearance of this lace might have been prevented by lapping each thread alternately at the turn again of the mesh. The cost of this machine was understood to be upwards of £3000; and the price at which its produce could be sold, would not justify its continuance in work. It was bought for £300, and has been reconstructed for an ordinary purpose.—Mr. William Clark introduced a method of using iron plates instead of cards, having pins on the surface as well as holes. In 1866, this inventor took out a patent, No. 3108, for improvements in ornamental laces and other fabrics.

In 1844, Mr. Gravener Henson gave a plan and drawings to Crofts and Cox, of Lenton—

For putting one bobbin of the usual size at the bottom of a steeple-top carriage, and another of smaller size at the top of the same. The bobbins above the bars being of the same size as the bottom bobbins, a fixed thread passed round both bobbins to which the bobbin thread was attached, and was wound round both bobbins which were placed more than two inches above the others, holding double the quantity of thread, and the bobbins pulled nearly alike so that no yarn was wasted. Henson learned that this method had been applied with success by Ferguson, at Lisle.

Joseph Topham, in 1845, used a double Jacquard. A Manchester string Jacquard makes the net. The figuring is made by using stumps to every warp thread placed behind the machine, and operated on by a Jacquard the whole width of the machine.

Townsend and Revill placed at the side of a bobbin net machine, a large perpendicular wheel, having wooden knobs on its surface, from which levers were actuated, which moved guide bars. This was at that time a cheap method of making small patterns.

John Oldknow, of Lenton, made Lever machines this year, 24-qr. or 216 inches in width. It was intended to make muslin laces extensively from them, but as the bobbin threads did not traverse, the article fell into disuse.

Slater now applied sixty sheet-brass guide bars perforated for warp threads, and enabled Levers' machines to use them. 120 were put in, in 1844, and 200 such were afterwards used in one machine with wonderful results, until the introduction of Oldknow's perforated steel bars, which may be said to have indirectly revolutionized the Levers' fancy trade.

In 1846, Mr. Vickers, sen. and Mr. William Clarke, took out a patent, No. 11,042, for the manufacture of machine wrought velvet lace—one of the earliest efforts made to accomplish this.

Mr. William Vickers, jun., of Nottingham, assisted by Mr. Gamble, also a clever mechanician, constructed about the year 1850, a machine—

Having a central comb bar to receive a full set of carriages and bobbins; also, a front and a back comb bar to receive the carriages as they were selected and required for the purpose of forming the pattern. There were warp threads which traversed, but not a warp beam; and the bobbin threads performed only the

operation of twisting. This required but six motions, and those through half the usual distance only to form the mesh; so that it was an exceedingly quick machine, and it produced excellent net.

There was, however, a delicacy in its mode of operation, which though it might perhaps have been overcome, yet having already expended £1500 in its construction, and other more pressing things intervening, further proceedings were given up. This was one amongst several highly ingenious attempts to perform by mechanism, actuated by rotary motion and inanimate power, all the various processes used in the fabrication of pillow lace. These have been necessarily very costly in time and money; in this instance combining, after much simplification of their essential principles of action, those parts which are specially characteristic of the Levers', pusher, traverse warp, and double-tier machines.

About 1848, Mr. Peter Coxon, of Lenton, made embossed muslin laces from the Levers' machine. The article was too expensive, and did not sell in consequence. His method was to throw the wheels and tackle out of gear, and thus letting the warp accumulate where necessary for producing embossment. — Mr. Wilkinson made braid from the Levers' frame by extra guide bars and constantly interlapping; the exact method was not known to the trade. Similar goods were made by other modes.—Messrs. Ingoldby and Clark had brought out, in 1845, an ingenious but slow scolloping machine, for working which however licenses were bought freely for a time. It never became a really popular plan of making this kind of laces.

Mr. Barton, of New Basford, a worthy man and excellent mechanician, after years of intense study, devised and put together a compound machine of a very peculiar system, of which we are unfortunately in a position to give but a very slender account. The yarn of which it was made, was all put on bobbins, there being no warp. It had five comb bars and four sets of points, and required, we are informed, 240 motions to complete one series of meshes. But the result was as perfect an article as can be produced upon the pillow. In the report of M. Aubry on this department in the Exhibition of 1851, he affirms this to be "the most beautiful

imitation of pillow lace shewn there." It is very melancholy to have to record, that the strain upon his intellect and nerves cost Mr. Barton his life. He died by his own hand in December, 1845. The machine no longer exists, but a specimen of the work is given in Plate XVIII., No. 29, an undivided Valenciennes lace braid or edging.

Shetland woollen work begun to be made on the stocking-frame by Mr. Thomas Hill, of Nottingham, in the year 1854. He had made experiments with fine grey woollen yarn, with a view to produce falls similar to those knitted by hand in Shetland. No yarn of a suitable kind was obtainable for a time. Ultimately Walker and Co., of Bradford, were successful in producing it; and in the summer of that year the falls were introduced into London and Manchester with great favour, and have ever since continued in regular demand, both at home and abroad.

In the year 1862, T. Hill suggested to an intelligent workman at Hucknall, W. Farrands, that shawls might be made of these fine woollen yarns, by the introduction of the newly brought out bright colours, skilfully combined with the patterns in the borders. Samples in various styles found immediate sale in France. The manufacture has steadily increased, and now comprises other articles of utility and beauty for ladies' dress, and, if well made, are used in Spain, South America, and the United States.

These goods are made on stocking-looms, having a jack machine, in which is a set of points to remove the loops from the needles, placed in front of them. The spider-work formerly made on these jack frames had gone out of demand. Now about 100 of the wide ones are at work on these new fabrics. The yarns are become an important article in Bradford spinning, and fetch 4*s.* to 12*s.* per pound, according to quality, passing through the hands of several agents in Nottingham.

A far greater development would have been attained, had not the first productions been immediately copied of a depreciated quality, so as to be lowered in price.

The first order for shawls was for 1300, and were

intended for the London and Paris markets. While in course of preparation a sight of them was obtained, and they were met, when delivered, by an article offered at two-thirds the price. The Paris buyers seeing the inferiority of the latter, declined to risk the effort to make them fashionable—a result, which if attained, would have given them greater currency still in other countries.

This is a striking instance of the resuscitation of a body of old and, as was supposed, effete machinery for a valuable purpose, though in a somewhat different direction; and still more important, as shewing the folly of putting in jeopardy the demand for goods by infringing upon their quality.

In 1861, Edward Topham, formerly of Nottingham, now of Calais, took out two patents, Nos. 1778 and 2728, for certain appliances by which longitudinal meshes may be fabricated of lace, which meshes so formed may deviate from the usual course, inclining to or from, or be at right angles with the selvage of the tissue; and by which a fringe, or the appearance of one, may be imparted to these longitudinal holes, obtaining by machinery what had and could hitherto only be produced by hand.

This was effected by what were called 'fugitive' and 'drag' threads, because they were, while in operation on the machine, used as means of dragging or pulling the threads passed round them out of their usual course, and thereby altering and angularly distorting the meshes, thus producing a closer resemblance to pillow made lace; and also they had the name of 'fugitive,' being drawn out from the fabric to which they were superfluous, when the piece was made and in course of division into breadths of lace preparatory to sale.

There is no doubt a more complete resemblance to real lace obtained by this method, than by what was formerly adopted, viz. putting on additional or lessened weight or tightness in the action of such warp threads, or such bobbin threads as might be required to drag, or to be themselves drawn aside, more or less, in the work. By consequence, Topham's plan and goods, the latter in black and white silk laces, good in style and rich in finish, were in request. In 1862, he brought an action against James Hartshorn for infringement, when it was proved that the defendant had not been able to make

the lace until he had obtained a pattern of it, on which the drag threads remained as it came off the machine. The jury decided the plan to be new; that the defendant had infringed it, and that the specification was sufficient. The right to the use of this patent, having passed into other hands in 1866, the Master of the Rolls and a jury tried a cause for its infringement—Barnett *v.* Maxton, in which a verdict was entered for the plaintiff, whereby the sale of goods, wherever made according to the plan, except by license, is declared illegal. The defendant agreed to take licenses from the plaintiff.

In 1863, this house obtained No. 773, for further improvements in ornamenting lace.

Mr. Frederic Rainford Ensor, of Nottingham, has devised many methods whereby laces may be made more approximate in various particulars to Valenciennes produced on the pillow. He has taken out patents for some of those, though not all. One of these patents was No. 2344, in 1854; another in 1855, No. 2142; another, in conjunction with Mr. Jacoby, in 1858, No. 2216; another in 1865, No. 971. The last he describes as—

"Producing from a single complement of threads all the pillars of the ground of three threads; also perfect cloth work, the tabby weaving being clear; the carriages swing in the same grooves; that is, one thread up and one thread down, alternately. It is a perfect, simple, and economic mode of producing by machinery Valenciennes lace."

The plan thus patented appears to be one of very great value. In an advertisement upon the subject of this invention, "Mr. Ensor reminds Mr. John S. Butler, Messrs. Dunnicliff and Smith, and Messrs. Jacoby and Co., that much lace is making under it." On enquiry into the meaning of this, we were informed that there may be a question raised ere long, whether a patent No. 113, taken out in 1863, by Mr. J. S. Butler, may not be in some points infringed upon by Mr. Ensor. Mr. Butler states his invention to be—

For the manufacture of Valenciennes laces by the arrangement and combination of carriage threads and warp threads, or of these with gimp threads, so as to produce net of any guage less than the actual guage of the machines on which it is produced.

The rights under this patent were vested in Messrs. Dunnicliff and Smith, and Mr. Jacoby.

Mr. Jacoby had already taken out a patent in 1859, No. 2772, for an improvement in this class of laces. In 1860, No. 1406, another in connection with Redgate and Stones, and No. 2016 and No. 2348, all three for variations in methods and results in making the same valuable class of articles. One at least of them has four threads to the pillow. Besides the patentees, Dunnicliff and Smith only are 'partially' licensed to make goods under them. The reader will readily excuse the absence of a more specific account being attempted of these very abstruse modifications and results, which would indeed require plates of machinery and patterns to make them even partially intelligible. The like must be said of patents obtained by another house, Messrs. Hartshorn and Redgate, for modifications of Levers' fancy machinery. These were in 1862, No. 1907 and No. 2472; in 1863, No. 2236; in 1864, No. 2066. Again, in 1864, No. 2676, in connection with Gadsby; and in 1865, No. 566, with Redgate, for making Maltese lace. The two last are advertised as the property of Mr. James Hartshorn and Mr. Jacoby. In the plan for making Maltese lace there is a peculiar mode of weighting the two warp and two bobbin threads respectively, producing, if wished, pearls either on one or both sides of the weaving edges.—A machine for making velvet spots was patented by Mr. J. Foster in 1855, No. 328. Also, in 1855, Messrs. Ball and Wilkins obtained a patent, No. 1618, for improved warp fabrics, and in 1862, No. 613, for further modifications.

Messrs. Hemsley patented, No. 2035, in 1855, for manufacturing chenille. In 1862, Mr. P. R. Couchoid took out No. 906 for chenille lace. The same year M. A. Fontaine Collette for "a new kind of lace," No. 3424; and M. l'Amadeè for an imitation guipure for veils, &c. A curiously constructed series of apparatus was patented in 1865, by John Wilkie, No. 801, effecting—

1st. Pearling edges from the warp, and from the warp and bobbin threads in nets. 2nd. Forming spots simultaneously with, but separately from the body of the fabric. 3rd. Producing fabrics in imitation of sewed brocade and fringed fabrics.

Mr. Henry Mallett took a patent, No. 1512, in 1866, for Valenciennes lace:

On this plan the pearled loops are closed at the stem of each, and are there intersected by a single thread, while the loops forming the pearls are each beyond the stem produced by a single thread, or two threads slightly twisted and worked as a single thread. The ground is produced by the employment of two warp threads to each bobbin thread, and where weavings are to be produced, the pairs of warp threads are wound on separate beams, so that the two warp threads of a carriage or bobbin thread may be worked up unequally; and then in place of the pairs of warp threads passing through the weaving side by side and as one warp thread, and also in place of employing extra warp threads as weft threads, one of each of such pairs of warp thread is used as weft threads or as a boundary thread to the weavings, and thus the corded effect heretofore resulting from the use of pairs of threads, as single threads in the weaving is avoided; and the cutting off of threads, as when extra wefting threads are used, is unnecessary. The weavings thus produced are like what have been produced when using one warp to each bobbin thread, and they are formed on a ground of net of two warps to a bobbin.

Provisional protection was granted in September, 1866, to Mr. William Selby, draughtsman, Nottingham—

For a method of making ornamental meshes or weavings in any part of bobbin net twist lace, by throwing out of work any of the regular warp threads and throwing in extra warp threads, by which the fabric is continued until the desired weaving or meshes be completed, the regular warp threads being carried over until again required to produce the fabric in the ordinary way. Messrs. James Hardy and Co. are alone authorised to make or sell the lace made under this patent.

Within the last fifteen years the attention of mechanicians, chiefly in France, has been turned afresh to the construction of machines for the fabrication of fishing nets.

The want of space forbids our giving more than the names of the inventors with the dates and numbers of the several patents which they took out, for facility of reference. In 1852, No. 841, Pierre Arnaud Compte Fontaine Moreau. In 1853, Nos. 145 and 2758, G. E. Gazanaine. In 1856, No. 2510, A. Bonnet. In 1858, No. 1234, F. J. Candy. In 1859, Nos. 1856 and 1872, J. and W. Stewart. And in 1860, No.1546, Hervieux brothers; No 1843, L. Rome; No. 1174, B. Arnold; No. 2879, J. B. Payne. In 1861, No. 2340, Baudouin. In 1862, No. 2018, W. Clarke.

It is very probable, that amongst these machines there may be found, on careful examination, many examples of novel and ingenious plans and of clever constructions applicable it may be in other useful forms.

From the silence into which at least in this country they have fallen, we fear they have met with the neglect which befel their forerunners in this department, and it is not unlikely for the same reasons, the want of demand—the fisherman making his own nets during hours which would otherwise be wasted. But though not directly useful and profitable, past inventions, however apparently simple or trifling, if real, are invaluable as facts to be studied, not only on account of what they contain, but still more for what they suggest, and what they teach the inventor to avoid.

The statistics of the machines, wages, and returns in the lace trade, have continued to receive a large measure of attention from time to time. No account was taken of the bobbin net production between 1836 and 1843. In the latter year the business was much depressed, and, on an inquiry being instituted, it was found—

That wages in every department of plain and common fancy nets were reduced so that the younger machine hands did not get more than 10*s.* and the men 16*s.* to 18*s.* a-week; though a few making plat nets were paid £2. 10*s.* to £3. weekly; a square yard of plain net sold this year for 4*d.* but the like quantity of plat lace was sold from £5 to £10. There were in the whole 600 machines less than in 1836; 500 had been broken up and 100 sent abroad. Only 2600 were at work; 2300 of these making cotton and 300 silk goods; of these 1500 made plain and 1100 fancy work The returns were only about £2,390,000, which sum passed at that time through about 100 houses in Nottingham, chiefly by way of London, and more than half consumed at home. 100 machines had been put on with Jacquard apparatus.

The warp lace business at this time employed about 800 machines, of which 500 produced cotton and 300 silk goods making a return of £350,000, being £200,000 cotton and £150,000 silk. This added in bobbin net, made the total returns £2,740,000.

At the request of the Board of Trade, the author drew up a fresh account in 1845—

From this it appeared that 3200 bobbin net machines were at work, of which 2800 made cotton and 400 silk net; 1650 of these being plain and 1550 fancies. The total returns were £2,995,000. The warp production had not materially varied, so that the entire lace trade returned £3,345,000.

The next account was computed from a census of machinery, making both bobbin and warp net, taken in 1851, by Mr. Birkin, and reported upon to Class 19, Exhibition, London, in 1851:—

He found then at work 3200 machines of total width in reckoned quarters 34,382, representing a capital of £1,329,445, to which there must be added further capital for buildings and machinery for working them; also for machinery in cotton spinning, silk throwing, dyeing, bleaching and dressing; and for smithing, bobbin and carriage, guide-comb and point making; besides capital in embroidering and finishing. These items were estimated at £1,616,500. The annual returns of production as sent from the machines were £2,300,000 to which embroidering, finishing and profits required to be added £816,000—total £3,116,000. The hands employed in making were computed to be about 20,000; in embroidering and finishing 113,000;—total 133,000.

The number of warp frames then employed was 150 making blonde and other silk laces, 150 cotton tattings, and 100 lace gloves and mitts; 400 in all, now become 90 to 100 inches in width, and making a return of £700,000 on a capital of £360,000. This makes the entire returns of 1851 in bobbin and warp lace £3,816,000. This branch employed about 10,000 hands altogether.

On the occasion of addressing the Society of Arts, in 1856, upon the history and then state of the machine-wrought lace trade, the author again made a careful enquiry, and found that—

The bobbin net machinery at work was 3,500 of full 40,000 quarters in width; a larger proportion was employed on silk materials; and the frames making fancies were 2158, mostly Levers'; the rest pushers, traverse warps, and a few circulars. The materials were all imported and cost £920,000; wages and profits amounted to £2,760,000—entire returns in bobbin net £3,680,000; 1350 rotary circulars were worked in power factories; and 1050 or more Levers' fancies were put on to power.

In warp goods made from 900 machines £60,000 was paid for materials and £300,000 wages and profits; returns £360,000 making £980,000 for the materials; £3,060,000 wages and profits; and £4,040,000 total returns of both branches. The number of hands employed was stated to be 135,000.

The returns shew to what an adverse extent the competition of bobbin net silk goods was now operating on the silk warp lace production.

So great was the impulse given about this time to the production of fancy lace goods in increasing variety and excellence, that within a single year, 1856, the number of machines to which the Jacquard apparatus was applied had increased about 400; almost all making the most expensive silk laces, Spanish shawls, and Maltese imitations. The materials increased in cost to £1,215,000, wages and profits to £3,565,000, and total returns to £4,780,000; about two-fifths of this production were exported.

In the enquiry caused by the proposed Treaty of Commerce betwixt France and England in 1860, Messrs. Boden, Bradbury, Barnett, and Vickers, representing the Nottingham lace trade, themselves owning 300

machines and employing 1200 workmen, stated to the commissioners—

That there were at that time 2000 English frames making silk lace goods, viz. bobbin net fancies 1030 all Levers except 44 pushers, 370 plain, making 250 to 350 racks a-week of Illusion, Mechlin, Chantilly, &c.; and 600 warp (out of 1000) making plain lace goods on 200 or so, and the rest fancy goods, instead of as formerly employed on Jacquarded shawls, mantillas, &c. These are now superseded by the cheaper goods produced at Lyons. The total demand for English silk net was described as not good, being met by superior and cheaper goods from France. The English machines produce an annual value varying from £480 to £1200 each, according to the kind of goods. The warp workmen gain from 16*s.* to £1. 10*s.* a-week; pushers £1. 5*s.* a-week, Levers' fancies £1. 16*s.* to £2, requiring the best hands.

Messrs. Heymann and Ward also stated that—

There were about 1540 English bobbin net frames making cotton lace; of these 750 made plain, and 700 fancy goods, and 90 curtains, and there were 300 warp machines making fancy goods. The machines cost on an average £230 each without Jacquard apparatus. They may work 15 to 20 years, but usually require repairs in 10 years. Each machine may produce £480 to £720 per annum, wages paid vary from 18*s.* to £1. 15*s.* sometimes however rising to £2. 10*s.* a-week. They averaged £1. 8*s.* The finishing adds according to stiffening 15*s.* to £1. 15*s.* to the rough cost. This rough cost consists of 70 per cent. yarn; 15 wages, and 15 for capital, expenses, &c. Stiff dressing may increase the weight of a cotton piece of net three-fold or more. Half the entire production was at that time exported leaving half to enter into home consumption.

The following is an account of the state of the machine-wrought lace trade in 1865. It is based on Mr. Birkin's census, presented to Class 24 in the London Exhibition of 1862; and upon an enumeration of the hands employed in and by a certain number of machines made by the author recently:—

At that time there were 1,797 circular machines making bobbin net; of these 200 were at Tiverton, 100 at Barnstaple, 360 at Chard, 500 in Derbyshire, and 700 in and near Nottingham. Also, 1,588 levers, 125 traverse warps, 42 pushers, all in Nottingham and its neighbourhood, making a total, with 353 standing, of 3,552 bobbin net, and 400 warp lace frames. Of these 2,149 were making silk lace, and 1,450 cotton lace. There were employed on plain net 1,442, and on fancy 2,157, the latter being closer imitations of cushion lace than ever before made. Although since 1862 there have occurred great fluctuations in demand, and the prices of both silk and cotton materials have advanced full 75 per cent., the amount of machinery and employment was in 1865 about the same as 1862. The entire production continues to be finished and sold in Nottingham, except that made at Tiverton, which is of silk, and sold in London.

The approximate number of hands employed in 1865 is calculated upon the account taken by the writer recently of the hands actually engaged in making and finishing the production of lace from a large body of bobbin net machines. These, for the whole body of the lace machinery, may be thus stated:—900 men employed in 180 shops for making machines, bobbins, carriages, points, guides, combs, needles, &c., at average wages of 33*s.* a-week; 10,300 men and youths at work in 130 larger factories and in lesser machine shops, 1,800 of whom may earn 16*s.*, 5,000 25*s.*, and 3,500 first-class Levers' hands 35*s.* a-week on an average. These all work alternate shifts of four and five hours each, in the entire day of eighteen hours during which the engine is going. 4,200 boys clearing, winding, threading bobbins, 5*s.* 500 women filling bobbins and overlooking, 12*s.* 15,000 brown net menders, who usually receive nets from factories, and free them from foul, broken, or uneven threads. It is generally supplementary labour to household work, by which 4*s.* to 8*s.* may be gained, averaging 5*s.* a-week. 300 men, warpers, 25*s.*; 300 men, moulders, founders, and superintendents of machinery, 35*s.*; 60 carpenters, 30*s.*; 360 porters, 17*s.*; 120 carters, 20*s.*; 90 watchmen, &c., 20*s.*; 260 steam engineers, 22*s.*; 150 bleachers, 30*s.*; 100 male dressers of lace, 8*s.* to 30*s.*; 900 female dressers, 10*s.*; 1000 female white menders, 12*s.*; 500 female lace folders, 10*s.*; 1,000 paper box makers of both sexes, 7*s.*; 450 warehouse women, 13*s.*; 250 female over lookers, 15*s.*; 100 draftsmen and designers, 40*s.*; 1,300 warehousemen and clerks taking salaries.

There are employed in each finishing lace warehouse from 6 to 600 females, as the size and nature of the business may require. The number cannot be known except by actual census. They are taken from out-door hands in brown mending and other employments on lace. The hours are 8 A.M. to 6 or 7 P.M., and the wages are about 9*s.* on an average; overtime is paid for. The kinds of work must be seen to be understood, but are in general more wearisome than heavy. In some of the factories and work rooms, in lace warehouses, and in dressing-rooms, the heat is sometimes oppressive. In general, ventilation is provided for, but hands do not always care to make use of it.

There is a far greater number of females employed, sometimes from a too early age, in the houses of "mistresses," often their own mothers, upon drawing, scolloping, carding, &c., processes light and simple enough, upon goods which have been obtained from finishing houses. These young people must exercise care and cleanliness on the articles, or they would be spoilt. When returned to the warehouse, the mistress receives a price, out of which she takes a portion for her labour, risk of damage, fire, light, house room, &c. Some of these persons employ as many as twenty young girls. The total number cannot be known accurately except by census. It being considered domestic employment, they are not under registration or visitation, except upon complaint made on sanitary grounds. A great improvement has been going on in regard to the age at which these children begin to do this kind of work, and the hours of their daily labour. The change dates from Mr. Grainger's report on this important subject in 1844.

The remaining department of female labour in connection with

the machine lace trade, is that of embroiderers with hook or needle, tambourers, or lace runners, once amounting to 150,000, now reduced to a sixth of that number. Their average weekly earnings in 1836 were 4*s.*; now they are doubled, and more for the better kinds of work. As fast as the improved machinery produced figured work, nearly finished on the machines ready for sale, the lace embroiderers were cast aside. About 1840 an immigration set into Nottingham from all the districts within fifty miles, to supply the increasing warehouse and out-door female labour required in both the lace and hosiery trades. There has thus been added to the already preponderating female population of the place, 13,000 within the last twenty-five years. In these three classes it is computed there are from 90,000 to 100,000 females, which, added to the 38,000 above enumerated, make a total of about 135,000 employed in the lace trade of Nottingham in 1865. The materials worked up cost about £1,715,000; the wages and profits amounted to £3,415,000, or thereabouts; and the net returns may be stated at £5,130,000.

In Nottinghamshire there were, in 1864, 250 lace manufacturers, of whom 180 finished goods produced in 132 machine factories; 10 master machine builders; 20 bobbin and carriage makers; 35 machinists; 6 machine brokers; 11 guide, point, and steel bar makers; 18 engineers; 59 lace agents; 33 dressers; 14 starch makers; 18 cotton and silk doubling mills; 19 paper box makers; 6 Jacquard makers; 34 designers and draughtsmen; 40 bobbin net and cap makers; and 15 public warpers.

In Derbyshire there were 20 lace machine holders.

In the working of power lace machines, there is still the anomaly of eighteen hours' continued working of the engine in the midland factories. The women and children are now withdrawn from night labour. It is more than questionable whether the natural hours of adult male labour might not, if universally adopted, result in, at least, equal advantage to the owners of these machines, costly as they are, yet working to little profit, and conduce greatly to the comfort and morality of the workmen and their families.

In conclusion, the condition of the children, probably not much fewer than 40,000 employed by mistresses, and the circumstances attending such numbers being confined so many hours in rooms not intended for workshops, would seem to call for authorised inspection, and, we think, for registration also. The evidence taken by Mr. White, a sub-commissioner, in 1863, upon the subject of the employment of children in these trades, and his report thereon, are full of important matter; deserving of early practical notice, with a view not only to these young people working under circumstances

more favourable to their health and morals, but also to their obtaining a sound education; which, under existing arrangements, is for the most part out of the question. It is announced that Her Majesty's government will introduce a bill into Parliament in this session, 1867, which, if carried into effect, will put under inspection and control this as well as some other branches of juvenile labour — a consummation earnestly to be desired.

Ireland has participated, though but to a small extent, in the lace manufacture. During the period when plain lace net was so extensively embroidered by the tambour hook, or needle, as to give employment to 150,000 females, a successful effort was made to introduce this department of labour into Ireland, by Charles Walker, Esq., a native of Oxford and student in the University, and who afterwards signalised himself as an engraver by his evident taste in design. Having married a lady, mistress of an extensive lace manufactory in Essex, and thus becoming interested in the style and finish of the articles produced, it occurred to him, on a visit to Limerick, that the labour of young females could be obtained there at a comparatively cheap rate, and with great local benefit. Being encouraged to make a serious experiment, he became tenant of a large building at Mount Kennett, which afforded the essential requisites of ample room, good light, and thorough ventilation. This he opened in 1829, and six girls became the first lace tambour workers in it. The first year was one of continuous outlay; the children had to be *taught to work*. Twenty-two young women, skilled in the art of lace embroidery, and four in muslin work, were taken over from England, to instruct and lead on to that amount of proficiency, which would justify paying the children for their work. As they improved, their earnings increased. This addition to the family income made the new employment popular amongst labouring parents, and the public mind became interested in the success of the new enterprise. It had an excellent social and moral result, especially coming in aid when the provision trade was suspended. The wages averaged about 3*s.* 6*d.* a-week, though the more advanced hands obtained

from 5*s*. to 8*s*. a-week; equalling or exceeding the earnings of the head of the family. Twenty years after, the establishment had become a well-developed source of profit to the employer, and of benefit to those in his employment.

Several prosperous branches sprung from this parent institution. The most extensive is that of Mr. McClure, who had acted as Mr. Walker's manager; and who, in 1856, employed 550 girls and young women in embroidering Nottingham plain net, so as to be ready to be made up into articles suitable as veils, shawls, scarfs, jackets, or dresses, for the attire of ladies in the highest circles.

CHAPTER XXVI.

THE MACHINE-WROUGHT LACE MANUFACTURE OF FRANCE.

The employment of females in making cushion lace had become general in several of the northern and central departments of France before the year 1600. Their labour was directed for the most part to making heavy articles used as ornaments for bishop's rochets, priest's robes, altar cloths, ladies' clothing, and bed furniture. Between 1600 and 1700, 'point d'Alençon' was fashionable, and its manufacture had greatly extended. The patronage of Mary de Medici, followed by the efforts of Colbert to introduce fine Flemish, Italian, and Spanish points, were crowned with success. French importation of these goods from abroad rapidly declined, while every kind of hand-wrought lace was more and more the object of attention and use, in both male and female dress. There was no part of the attire of either sex, from their heads to their feet, which was not ornamented by the addition of lace, often of the richest and most expensive kinds.

Fashion dictated from time to time variations in materials and colours, or grounds and styles; but there has scarcely been an epoch since the age of Louis XIV. in which lace of some kind has not been a favourite article, and used according to their means by all classes throughout France. An almost entire cessation took place during the time of the first revolution; but the consumption of lace was re-established by the ladies of the court of Napoleon I., and in one form or other it has continued to be fashionable ever since. The exception was a brief one, serving to sustain the general rule.

France took the lead of the other countries where lace was made by hand in amount, if not in quality,

an hundred and fifty years ago, and keeps that position still; so that according to M. Aubry (report in 1851), of the total number of hands employed in Europe, 535,000, producing a return of about £5,500,000 per annum, 240,000 were French workpeople, making nearly £3,000,000 of goods a-year; while Belgium, the first important home of the trade, employed only 95,000 and England 45,000; the remaining 155,000 were spread over Germany, Spain, Italy, and the rest of Europe. It was natural that France should be on the alert to put into operation any inventions that might by producing lace on machinery, so far lessen its cost, as to place it within reach of every class of society. Accordingly, the adaptation for this purpose of the stocking-frame in England, soon became known to French manufacturers of hosiery; amongst whom no modifications in that machine of any importance had occurred since its first introduction into Paris by John Hindret, in 1656.

Hearing of these lace making inventions, Louis XVI. when he sent the Duke de Liancourt to England in 1774, directed him to study the machine on which lace was made, and one Rhambolt was sent with him as a workman. The latter learnt at Nottingham to work Harvey and Else's 'pin' machine, and then took it to France. Tricot open-work silk net was made on it the same year by Bonnard at Lyons, and it was for a time the only machine used there for making lace. The Republican government are stated to have granted 110,000f. (£4,400) as a reward for its introduction. From France it was taken to Austria. The articles made from it are called "Tulle simple et double," and in both countries they are still made in large quantities.

From this time France became a close and powerful competitor with England in the manufacture of this and successively of all other kinds of machine-wrought lace. The produce from the 'pin' machine, by the French at the end of the last century, was greater than that of 'point net' (a similar article) by the English. There were 2,000 frames of the former class at Lyons and Nismes, and 1,200 only of the latter in England. In consequence of the better quality of the 'double

press' goods made in Nottingham, and the preference given to them in Paris over the Lyons 'single press,' the English article was prohibited entry into France. M. Aubry states—

> "That the use of the English 'spoon tickler' apparatus was mainly instrumental in improving the silk net productions at Lyons; and that those who worked with it about the year 1800, often gained from 12*s*. to 20*s*. a-day, wages. The product had become so large in 1810, as to require a special representative for it in the 'Conseil des Prud' hommes' of that city."

From the year when the 'pin' machine was introduced into France, the efforts of ingenious mechanicians in that country were put forth to make advantageous alterations in it, and these were followed by much success. There is a mythical claim put forth, on behalf of an unknown workman of Nismes, to the invention of the warp machine. Warp net had been imported from England in 1775. The earliest notice of an improvement tending to making lace, was of one on the stocking-frame, for which Caillou, in 1778, received 1000 f. (£40) from the French Academy, and from government an honorary position in the frame-work-knitters guild at Paris. This was for making a web entirely of open work. No description, either of the machine or article, is given. In 1791, Jolivet and Cocher took out a patent for making improved silk net. Hayne, one of the proprietors of the English patent for making 'barley-corn' net, being at Paris in 1802, making arrangements for smuggling it into France, was detained when war broke out. Napoleon wished him to set up a machine, but he preferred his illicit business. In 1809, he was denounced by his own agent, and 1,500,000 f. (£60,000) worth of his goods are said to have been seized and burnt. Being completely ruined, he fled to England; but this event drew so much attention to mechanical lace manufacture, as to cause skill and capital to flow into it.

As regards the 'pin' and 'warp machines, various subsequent inventions, chiefly patented, must be briefly enumerated. In 1802, Jourdan and Son obtained a patent for further improvements in silk net. In 1806, Bonnard, who was an eminent manufacturer, made this article double knotted and of a fixed mesh. These

machines then employed 15,000 embroiderers, chiefly at Courdrieu (Rhone), and the goods were sold largely both in France and Spain.

In 1809, lace patents were taken out successively by Le Grand of Paris, Jarman of Lyons, and Devrieu and Pien of St. Etienne. One of these was for a crossed meshed net, 'tulle de glace.' In 1810, by De Passy, and Jolloet and Pochet of Lyons. In 1812, by Gillet and Jourdan of Brussels, and by Pinet of Lyons. In 1813, by Coutain of Lyons. In 1818 by Maynard of Nismes, for warp knotted silk net. In 1821, by Benoit Allais of Lyons, for warp fancies in symmetrical patterns; and other patents by Cochet of Lyons, and Galmo of Paris.

Warp machines were now largely employed at Lyons in making silk blondes and net for embroidered shawls, veils, mantillas, &c. It is stated, that the first applications of the organ barrel, the Vaucanson chains, and Jacquard cards, were now made to the Mechlin frame; and to the warp in 1824, by Colas and Delomprè, of Lyons, so as to produce silk lace patterns on it. In 1826, Gregoire and Hombard, of Nismes, patented the most perfect Jacquard application to make embroidered warp blonde nets, which were made up into shawls, veils, and scarfs of great beauty. All these were however looped fabrics, whether of point or warp net, and had neither the appearance nor durability of cushion lace. The frames on which they were made did not cost more than £10 to £20 each; whereas the bobbin twisting and traversing net machines, now brought into operation, cost £200 to £1000 each; and with their sounder productions looped nets could not for a time sustain competition. Like as knotted point laces gave place to warp fancy goods, so these gave way to the superior excellence of bobbin net.

Lace, the product of English machines, could not be smuggled into France under a premium of 30 to 35 per cent. This strict watchfulness of the French custom-house officers, caused every possible effort to be made to obtain and smuggle away from the other side of the Channel, one of these bobbin net machines. This was at length accomplished, at great risk of incurring the severe penalties inflicted by the English law then in existence against that proceeding, and which for twenty years after, the English trade sought at some expence

to put into active operation. When referring to this Act of Parliament, more than one French writer says its infraction rendered the infringer liable to be put to death. This was never the punishment in England for the export of machinery.

The following narration is drawn from the published statements of Messieurs Aubry and Ferguson, as well as from other authentic sources, and is intended to give an accurate idea of the steps by which the French bobbin net lace trade has so rapidly become one of the most important textile industries of that country.

Cutts, who had been a workman at Loughborough in the employment of Heathcoat, with the funds and other assistance of Hugo Young, got over to France an 'Old Loughborough' machine; and during the one hundred days in 1815, began to put it together at Valenciennes. Young, fearing the results of the political state of things in that part of the continent, went back to England. Cutts now met with Black and they went together to Valenciennes. But the siege of that city caused them to transport their machine to Douay, where it was finished and set to work at No. 22, Rue St. Albin. Cutts and Black there took into partnership M. Corbit, an aged currier of Cambray, and M. Thomassin, under the firm of Thomassin, Corbit, and Co. On the 14th of August, 1816, they deposited their claim to priority of importation at the Prefecture du Nord, and got a patent, November 15th, 1817. In 1816 they had caused a robe to be made on this machine, which was embroidered by Madame Ward, for the purpose of being presented to the Duchess d'Angoulême. Thus that princess wore the first machine-wrought bobbin net lace article made in France. Mr. Ferguson possesses a portion cut off from the same piece.

In 1818, Messieurs Corbit, Black, and Cutts were, after a judicial inquiry, declared to be the earliest makers of bobbin net in France.

The first machine set up at Calais was one 36 inches in width. It was constructed in England by James Clark, and partook of the pusher and traverse warp principles. It was smuggled in parts by French sailors into Calais at the latter end of 1816, and Clark got it to

work in the Faubourg St. Pierre, Rue de Commerce, Nos. 712 and 713, Bonser and McArthur, two Leicester twist hands, making net upon it. This frame led the way to a partnership between James Clark, Webster, and Bonnington. Mr. Bonnington was the father of the celebrated young painter, Parkes Bonnington, who studied that art in Paris, where his father went to dispose of the bobbin net which was made by the firm. Clark was described as being a clever mechanic, but this is doubtful: however, with the aid of West and Dobbs, father and son, several other machines for making net were put together at Calais. Their union did not last long. Clark set up another lace factory there. The following entry was made in the records of the chamber of commerce in that town:

"James Clark, Richard Polhill, Thomas Pain, Edward Pain, and Thomas Dawson, five Englishmen, appeared before us, the Mayor of Calais, to declare that from this day, 13th April, 1819, they form an establishment for manufacturing of nets, called warp and twist."

Their first machine was a fifty-four inch eleven-point, and was secretly worked at the house of Polhill, in Rue de Clocher. The fabrication of bobbin net at Calais remained chiefly in the hands of Clark, Bonnington, and Webster until 1821; and of warp in those of the five partners above named. There were several 'straight bolts' got over to Calais between 1817 and 1824. In the latter year, M. Dubout Ainè (Dean of the Calais lace manufactures in 1862) joined Austin, who had several 'point' Mechlin machines. Then he bought a bobbin net machine of Mr. Cliff, sen., now of St. Quentin, and of whose establishment and career a separate notice will be given. This, when at work in the hands of a French house, alarmed Clark, Webster, and Bonnington, who offered him £80 for his purchase. This Dubout declined, saying, "he was young and wished to follow the course of this business, for it pleased him." It is asserted that under his direction, the first really French bobbin net machine was built by a Calais workman, named Mechaut, who, in 1824, was a fellow workman with M. Lieven Delhaye, the mayor of Calais, in 1862. The intercourse which the author had with the latter gentleman, as jurors at the French Exhibition in 1855,

will ever be remembered by him with pleasure; and it causes him much regret, that in the instance of M. Delhaye, as well as of several others, both Frenchmen and Englishmen engaged for years in this arduous enterprise, it is not in his power to give particulars of the interesting incidents which must have occurred in the career of each. Clark went to reside at Lisle about 1822, and there joined M. Mechu.

Many English bobbin net workmen emigrated to Calais, Lisle, Cambray, and other towns in France, so that St. Pierre, which in 1816 had but 4000 inhabitants, became in a few years a large suburb to Calais. Lace making was the only manufacture of the place. The machines already at work were transferred to St. Pierre from Calais; the noise made by their employment in the night having been complained of. At St. Pierre the hours of labour were unrestricted. The inhabitants numbered 11,000 in 1851. By this time the Calais authorities had found out their error, and the interference with night labour was discontinued. But it was too late; and the population of St. Pierre had increased to 14,779 in 1862. When it is considered that in 1810 Calais and St. Pierre had neither machines nor manufactures, the progress made by the energy and talent displayed there must excite the admiration of candid observers. St. Quentin, Douay, Rouen, Cambray, and Caen have each taken part in the fabrication of bobbin net; but it is Calais only that can be said to have become the Nottingham of France.

In 1818, Mr. Heathcoat, the English patentee, established a factory in Rue de l'Oursine at Paris, which he filled with a large body of his machines constructed to make plain goods on the circular or 'old Loughborough' principle, though by simplified methods. These were continued in activity there until he removed them in 1827 to St. Quentin, where they were worked under the management of Messrs. Hallam and Cross. They are now unemployed.

In 1825 the French bobbin net manufacture may be said to have become established.

There had been only about thirty-five machines set up in Calais in 1823, and probably not more than one

hundred on the continent altogether; but extensive arrangements were being made for their increase in France. The influence of the expiration of the patent in England extended thither also, and symptoms of progress were seen on every hand.

M. Dognin, sen., a pupil of M. Bonard's, took the first bobbin net frame to Lyons. This machine had been thought by the French only suitable for making cotton nets, but Mr. Heathcoat had produced silk nets upon it to a considerable amount in the year 1824, and in 1825 his patent raw silk (reeled for him in the Cevennes) was used at the factory at Paris in making silk net. M. Dognin, in connection with M. Poidebard, that year began to make a net which he called 'Grenadine.' It was made on a circular machine—a heavy article in imitation of Spanish pillow ground; and the silk thread used was of highly twisted singles, doubled with a heavy twist the contrary way. These goods when embroidered had a great sale, and put aside point net ground for a long time. Dognin produced, in 1828, another article made from very light silk, and the net traversed only one mesh, which was called 'Mechlin,' 'zephyr,' 'tulle illusion,' and 'point chainette.' It was dressed with little stiffening for ladies' toilet use, and obtained an extensive sale. In 1824, Deurieu and Pien, of Lyons, patented an imitation of Dentelle ground. About the same time Messieurs Jenny and Sailby bought a circular machine at Nottingham, and it was got to work at St. Pierre by Mr. S. Ferguson, sen. A 'Levers' was put into operation there in that year also. Soon after, Bonsor, the former twist hand, began to construct warp and Levers' machines at Lisle, where his son employs them still in the manufacture of fancy lace goods of each kind.

The plain nets made on 'point' frames being less in demand from competition with warp and bobbin lace, the French invented articles which were called 'porcupine' scarfs. These were made on those frames by repeatedly placing adjoining threads upon the same needle, thus forming protuberances. With these they supplied the European and American markets so largely as to cause the English to imitate them. After some

time they went out of fashion; the last of the Nottingham point frames were transferred by Berthaud to Lyons, and the French remained masters in the fabrication of that description of lace.

The making of bobbins and carriages now became a special business at Calais in the hands of Cobb, Walker, Greasley, Britton, and West; S. Ferguson also entered into it, and after a time they were made at Lisle and Lyons. Widdowson having arrived at Douay with a traverse warp frame, was accompanied by Cantello, who also made bobbins and carriages. Widdowson forged the hammer with which he constructed his quilling machinery, and his grandson, Mr. William Bailey, has the frames now in operation. In 1825, Robinson and Morley patented an improved Levers' machine. In France, as in England, these modifications of machinery have usually been effected by mechanics each upon the separate class in which he has himself laboured; and in which, knowing their component parts perfectly, they could adjust suitable alterations of the wheels, bars, and other parts.

Wasse and Duprè took to Amiens, in 1827, six circular frames, to which six more were slowly added. These were at first employed in making plain net, then quillings and fancies, and now curtains. A patent was also granted to widow Choel, of Lyons, for an improved circular. M. Aubry calculated there were in 1830, 1000 bobbin net machines in France, producing from £400,000 to £600,000 worth of cotton net. Capitalists had for some years entered more and more extensively into the business.

Messrs. Kirk and Poole built a machine in 1821, the produce of which Kirk sold, much to his advantage, at a house he established in Paris. Though he suffered considerably by the revolution in 1830, he was enabled to buy two circular and two Levers' machines. He took out four patents for improvements in them, between 1836 and 1840. He was a mechanician of great skill; aided by Keenan and Louard, he constructed nearly the first French marine steam-engine. But the vessel in which it was placed was too heavy, and it proved a failure. Keenan brought out a modified warp frame in

1830. John Bailey took the method of working bars in lace machinery by Dawson's wheels to Douay this year. Levers' and circular machines were also set up by Guilmene, Mingot, and Meats.

In 1831-2 there were said to be 3000 frames in France, on which point net was made. Their speed, with the quality and finish of the article, issued in its increased export to England. The amount of silk net sent out of France in the seven years, 1825 to 1831, was only £36,000 worth, and of silk laces, £32,000. Mr. William Morley, of Derby, reported to a committee of the English trade sitting in 1833, that he had reason to suppose, from personal enquiries in France and Belgium, that there were then 1,650 bobbin net machines in France, and 200 more elsewhere on the continent, producing altogether (at English prices) to the value of £570,000 annually. In an address to the French Government presented this year, asking for a free admission of English yarns, the writer of it, who states himself to be an original French bobbin net manufacturer, says, that their 1,500 good machines had fallen from a value of £600 each to an average of £120, and others were worth no more than old iron. He estimated that the French consumed bobbin net to the amount of £1,000,000 annually, half of which was of English, and half of their own manufacture. In 1834, M. Abiet, delegate from the bobbin net trade at Douay, stated to the Council General of Commerce, that there were in that city 22 shops, 96 machines, and 800 workpeople at wages of 9*s*. a-week for the best hands, the women and children averaging 3*s*. weekly. Widdowson, the owner of 23 machines, stated his fixed capital to be £8,000, and his returns of £2000 every three months carried on the concern. He used the profits in building new machinery. The general evidence contained the following statistical summary:—There were 1,500 bobbin net machines in France, of which 900 were at Calais, 400 at Lisle, and 200 at St. Quentin, and elsewhere. The fixed capital was £300,000, reckoning each frame at £200, and floating capital was £300,000; this machinery giving employment to 500,000 (?) workpeople, including embroiderers. According to the evidence, the prime cost of bobbin net was 60 per cent. higher in France than in England at that time. In a report made by M. Argout, in 1835, it is stated that there were then 1,585 bobbin net frames in France, and 6,850 in Europe.

In 1835, M. Dognin, jun. brought out his 'tulle Brussels,' which became fashionable, and about this time, Wootton set up his plain net and tatting machinery, which is still at work. M. Jourdan produced at Cambray plain silk nets from wide machines, so regular in mesh and superior in finish, as to be exported largely to England and the United States. This eminent manufacturer afterwards took out patents in 1838, 1839, and 1849 for the application of Jacquard apparatus to circular machines.

On these he at first made fancy white silk laces, with a Brussels ground. The experiment was very costly; and in 1842, he changed to the production of black silk laces, the cloth work in which was made by the machine, the thick thread was put in by hand. These sold well. In 1834, Champollion and Pearson patented the spotting apparatus in France, and the articles made from its use had a great sale. This patent was the forerunner of the Jacquard application to Levers' frames in Calais, and to the other machinery at work elsewhere in France. Since that time, there have been more than forty patents taken out in France for inventions in these machines, native or imported, having for their object more perfect imitations of pillow lace.

On arriving at this point in his analysis of the course of the French bobbin net manufacture, M. Aubry remarks—

"That this application of the Jacquard gave new life to the production of silk nets. The merit of this M. Isaac, of Calais, claimed to share with M. Jourdan, the first French patentee..... Rotary circulars were now so increased in width, and variously modified as that warp nets could not compete with them. And as the frames were gradually put on fancies first by the use of wheels and then the Jacquard, they attained still greater superiority in the estimation of French lace manufacturers...If England has the honour of the invention of the bobbin net frame, France justly claims the application to it of the Jacquard, which was indispensable to its continued existence, and is the basis of all novelty of production by it; and to the Jacquard is due the power of imitating real lace upon it. Together they constitute the most marvellous weaving instrument in existence."

With all due respect to M. Aubry, and an earnest desire to avoid writing under the influence of national or individual prejudice throughout this volume, we are constrained in the interests of truth to withhold assent to this claim. The principle of selecting at pleasure individual instruments, lies at the bottom of the arrangement and use of the organ barrel, the notched, nobbed, and eccentric wheels, as well as of the endless chain of perforated Jacquard cards. The last is without doubt the most useful in its application. The dates in this chapter, given entirely on French authority, if compared with those in the account of patent bobbin net inventions

by Draper, in 1835, and the discussions upon them as related in the chapters on the English lace trade, will, it is apprehended, show sufficient grounds for dissenting from M. Aubry's positive view of the matter. The proceedings on the one side of the Channel, however, followed so closely upon those on the other, and the rivalry has been on the whole so amicably pursued, that we do not care to discuss the question further. Each body of manufacturers has derived and may still derive so much benefit from the skill of the other, that they may well agree to divide the merit of almost simultaneously applying the Jacquard and gradually perfecting it equally between them.

Mr. Ferguson, referring to the memorial presented by the English bobbin net and warp makers to the Board of Trade in 1836, expressing their desire for free intercourse between the two nations, especially in the articles they dealt in, and which has never yet been fully accomplished, says—

"That neither the moment nor the man was yet come thus to benefit France." He further expresses the decided opinion, "that the principal reason which indisposed the French manufacturers to accede to such a withdrawal of protection, and entrance upon free competition, was the difference in cost, quality, and price of English plain nets, as contrasted with their own; and ascribes the adverse position of the French makers of nets to the fact, that the English keep their machines up to the highest point of excellence, throwing them when inferior to the scrap heap without hesitation, to be replaced by more perfect ones in system and construction."

This is an accurate statement of the English practice, which has been however carried to excess. Had the latter depended less on width and speed in their machinery, and looked more decidedly to quality of materials and perfection of finish in their goods; the loss by their destruction of narrow frames still capable of making good net, and outlay upon new ones of extravagant widths and cost, might have been to a large extent avoided, or extended over a long course of years. Besides which, from 1826 to 1838, more bobbin net was produced in both France and England than the national demand required; wages fell with prices, and for some time English workmen returned from Calais, where still the hands were more than half English.

The number of machines in France making single press point silk net had increased, in 1840, to 3,500. The returns of goods made by them amounted to £400,000 a-year. The dress put upon this net at Lyons was so superior as to cause the export to England to be doubled. In 1850, France exported £288,750 worth of silk nets. In 1851, England exported £160,000 worth of silk nets. There were many machines also at work in Spain, and some in Italy, besides the large body in Austria. From 1842 to 1846 there were 1800 bobbin net machines at work in France. The straight bolts had been superseded by circulars; and though costing originally £600, were sold for £10 each as old iron. 908 machines were still employed at Calais. These consumed materials which cost £320,000, and paid wages and expenses £160,000, making a return of £480,000 a-year. Of the materials £120,000 was English cotton yarn.

The 'pusher' machines in England, by using extra bars, guides, and stumps to act independently, had been in 1831 put upon imitations of fancy blondes, and narrow tatting breadths. In 1842, A. Isaac of Calais and C. Dognin of Lyons, applied to this and the other systems of bobbin net, the 'brodeur Isaac' and patented it. Its manner of operating was soon after improved.

H. Black, who was an equally good mechanician and manufacturer, brought out in 1844, a very good imitation of Valenciennes and Chantilly black silk cushion laces, and patented the process. The machine was half circular, half pusher. The mesh was a good one, and the effect superior to that in any other lace at that time; but the fining betrayed its mechanical origin. The produce of Black's machines was sold by M. Monard at Paris, and bore his name. Besides the above-named patent, and one for the Grecian net in 1830, Black took out others for improved processes by lace machinery in 1834, 1837, and 1847.

While, as might be expected from the difficulty of the subject, some of Mr. Ferguson's historical facts may be open to question, the author cordially agrees with the just and sympathising spirit which dictated the following (abbreviated) paragraph in his recent work:—

"By their importation of the bobbin net machine, Messrs. Black and Cutts endowed several localities with an industry, until then not known in France, and gave them fortune. We may add that one of these men who thus brought the country prosperity, is at this moment vegetating in it in the most precarious position. The son of Mr. Black came, in 1815, with his father, energetically assisted, and succeeded him in constructing these machines in several of our

cities. But a reverse of fortune has not left him with a single machine whereby to provide for his necessities. How many other pioneers of labour have been repaid by poverty for their services, and fallen into ruin by creating industries which have given riches to their more happy successors? Could there not be apportioned out of a patent fund modest pensions to these men, who have opened up the way along the field of industrial discoveries? It is objected they seek for profit, 'if successful, *they* gain it, not society; is it the duty of society to meet the results of their ill success?' We reply, 'soldiers and civil servants of the state receive the recompence of bread in old age.' We claim the like reward for these soldiers of commerce and founders of industrial wealth."

This will be an appropriate opportunity to mention the services to both the English and French bobbin net trade, rendered by Mr. S. Ferguson, sen., then residing at Sneinton, near Nottingham. He began his useful career by arranging the circular machine, so as to produce bullet-hole and Grecian nets, in 1823. This was effected by cutting notches in the back driving bar, so as to retain carriages stationary when needful. This plan was extensively used here. He afterwards produced both square net and wire ground. One of his workmen took the bullet-hole plan to Calais.

Mr. S. Ferguson, jun., his son—in his "Histoire du Tulle et des Dentelles Mecaniques en Angleterre et en France," from which valuable information in this account of the French manufacture has been derived—with excusable filial regard, "claims for his father the honour of having most contributed of any one, towards bringing the circular system of machines to perfection." Without attempting to decide that point, it is certain, that by his mechanical efforts the usefulness and value of that class of machines were considerably enhanced. In 1838, at the time of the American commercial crisis, he went to France, "to be certain of enjoying the fruits of his invention, which he had found impossible at Nottingham." After other adaptations, he invented a plan for using Jacquard cards, so as to produce on this machine an imitation of black Chantilly lace, scarcely to be known from its original, the Cambray pillow lace. For this he took out a French patent. He was now fixed at Cambray, in partnership with Jourdan and Co., already makers of silk net there.

In 1852, Mr. Ferguson made lama lace, of which

the bobbin yarn is made of mohair. Like the Cambray, this mohair has had many imitators at Lyons and elsewhere. Leaving in his plan the special system of the circular machine untouched, he acted on the bobbin threads by Jacquard cards, employing two extraordinary guides only. He was afterwards established at Amiens.

Mr. William Cliff, now of St. Quentin, was originally a workman in the lace trade at Nottingham. Messrs. Paget and Wallis, of Loughborough, having bought some lace machinery at the former place of a Mr. Ward, employed Cliff to set it up, and afterwards to work it. In 1818 or 1819, a straight bolt was bought at Nottingham by Bonington, Clark, and Webster, and taken to Calais; but the net made on it being inferior, could not be sold, and it ceased to be worked. In 1821, Webster had become its sole proprietor, and looking out for some one to put it into a profitable working state, Cliff was engaged; who, settling his affairs amicably with Paget and Wallis, removed with his wife and family to Calais. Having set smiths to work and taken other proper steps, in three months the straight bolt produced more in a day than it had done in a week, whereby this mechanician got such reputation at Calais, that he was soon offered orders for new machines. He began business as a machine builder in 1822, taking premises and setting up a forge. There he constructed amongst others, one machine for Dubout and Austin, two for Hopkins, of Lisle, and one for Storer. He then built a hand circular on a plan of his own, and sold it to Hopkins for double the price of the straight bolts, and he forthwith filled a shop with these circulars, straight bolts having fallen into disrepute. In 1825, the lease of his Calais premises being out, Mr. Cliff removed his business to St. Quentin, where he continued to build circular bobbin net frames, for which he obtained large prices. Some of these were worked at St. Quentin, others at Lyons, Courdray, and three at Vienna in Austria, where a respectable establishment was set up, and still continues in operation. The profits obtained from the circulars which Cliff had constructed for his own use, became unsatisfactory; and he therefore, as the French lace business generally

and that of St. Quentin in particular was become very important, decided to erect works for bleaching and dressing, not only his own goods, but those of others also. Both these processes had hitherto been carried on in a most defective way.

The town of St. Quentin was famed for the production of cotton articles called 'pignes' (quiltings), these with goods from Calais, Douay, Lisle, &c., he bleached and finished to such an extent, as in 1837, to require him to erect larger premises, in which steam-engine, pure water from an Artesian well, and attention to the minutiæ of details, enabled him to carry on the business to satisfaction. In 1847 his factory was burnt down, by which a loss of a-year's time was incurred, to be followed in 1848, by a change of dynasty in the government of France. These events, important in themselves, were not without use. As a practical man, Mr. Cliff took advantage of the opportunity thus afforded for replacing the old circular machinery with a body of thirty Levers' frames of greater width, and with the latest improvements, including the application of Jacquard apparatus to them all. Mr. Cliff's sons had now been added to the management, the firm becoming Cliff, Sons, Biddle, and Birkin—the two latter joining them with machinery from Nottingham. Since that time they have manufactured, under the management of Mr. Edwin Cliff, silk net, silk guipures, cotton guipures, blondes, Cluny, and other fashionable laces. This house obtained first-class medals at the Exhibition in 1851 and 1862. In 1865, the firm became Cliff Brothers, and Son. This important business, employing 300 men on the premises, is become of the first magnitude in France for the production of lace, and challenges comparison with any other home-made or foreign goods, in quality, finish, and price. Mr. William Cliff devotes his scientific attainments, which are considerable, especially in chemistry, to the bleaching and finishing of goods. The house took out, in 1861, an English patent, No. 2892, for improvements in the manufacture of lace.

In 1848, Dognin and Jourdan made an imitation of woollen lace on the bobbin net machine, like those

made at Puy on the pillow. In 1849, Kirk bought from Keenan two more circulars for plain net, besides two Levers' making fancies without, and two with Jacquards. He transferred through his son, two Levers and one warp machine to Barcelona at once; but the Spanish tariff on this kind of lace being lowered, the operation was only partially successful. Kirk, sen., continues his business at Caen. Levers' machines, to which the new brodeur apparatus of Isaac was applied, were now worked at Calais, producing imitations of blonde and Valenciennes.

In 1850, it was estimated that there were 300 to 400 warp machines at Lyons, together with 150 to 200 rotary circulars, and 12 to 15 Lever and circular Jacquard making bobbin net. The spoon tickler was disused in making point net. In 1851 there were at Calais 14 warp, 3 pusher, 124 circulars making plain goods, 141 circular and 321 Levers' Jacquarded for fancies; in all 603 machines. "The fancies produced there," M. Aubry in his report says, "were now preferred to those made at Nottingham, not only at Paris but also in London. Nevertheless many of the patterns made at Calais were still imitations of the English. Calais exported £70,000 worth of these goods in 1851. Though the number of frames was reduced one-third, their speed and the quantity and value of their production was increased considerably. Some of these Levers' with Jacquards cost each £1000."

Under the name of 'Dentelle de France,' M. Dognin had exhibited an article in 1844, and gained a silver medal for it. Similar goods were sold in Paris by M. Malaprè in 1851, under the name of 'Dentelle de Paris,' since 'de Creteil,' made by M. Gallope. They are of very fine silk.

The French estimate of the actual position of their machine-wrought lace manufacture as well as its relative progress in competition with that of England, will be best gathered from the report of M. Aubry on the Exhibition of 1851. The following are notes taken from it:—

"Forty years ago there was only one centre of this trade, Nottingham; now there are two, Calais having taken its position. The Jacquard system now operates alike on the greater part of the machinery employed in both places. All difficulties have disappeared, though formerly thought insurmountable, in the way of producing imitations of real lace. Whether from circulars, pushers, or Levers, admirably correct copies of pillow Chantilly goods are obtained. Cambray produces laces, shawls, berthas, scarfs, &c. Successful imitations of Caen blondes are made on French machinery. Every change of

fashion and taste may be met now by mechanical arrangements. It is true that there are 1000 machines (of which they say 300 are Heathcoat's) making silk blondes in England; selling the produce at lower prices than the French; and their plain cotton nets which were at one time 40f. the square yard, are in 1851 3*d.*" (4*d.* was their lowest figure.) "And their larger articles" (shawls &c.) "lower than the French in price; yet except those shewn by Vickers and one or two others, they are inferior in design. Their curtains require French taste ere the articles will replace the excellent embroidery of Tarrare and St. Gall, as they are probably destined to do. England is distinguished by the production of enormous masses of common goods; in these she need not fear any competition with the 3000 machines in Nottingham and its neighbourhood. Calais from its 700 machines exhibits products artistic, varied, and rich in design and fineness of tissue. Instead of servilely copying step by step the products of Nottingham as formerly, Calais is now developing its own ideas, which are more and more reproduced by English machinery. This is becoming a French industry, destined to take the first rank, if not in amount, in variety of design and facility of adaptation."

The report of the International Exhibition of 1855, says—

"That there were at St. Pierre les Calais, 610 frames of different systems, and 40 more building, employing 5000 men and women, and furnishing labour to 50,000 more. To these were to be added some hundred more machines at St. Quentin, Caudry, Lisle, Indry Cambray, and Paris, of the value of £200,000, returning yearly £800,000; to which adding embroidering and finishing, the entire returns would be at least a million sterling."

In this document the following paragraph occurs:—

"Machine wrought lace exactly fulfils every condition often repeated by H. I. Highness Prince Napoleon as to claims for prizes. The prices of the articles are such as to render them accessible to all classes. They are in perfect taste, and the improvements in their manufacture are such in some kinds as Mechlin, Chantilly, silk blondes and above all Valenciennes, that it is with difficulty even when examined closely, they can be distinguished from the same classes made by hand. And there is this happy circumstance, that far from damaging the business of making cushion lace, the progressive development of machine wrought lace, appears rather to have excited in regard to the former, which is essentially a luxury, a double activity beyond that of any former epoch; so that hand wrought lace was never before so much sought for by the richer classes, and the returns in it being never so great as they are to day. In the bobbin net business, incessant efforts are put forth and immense sacrifices are made, in the constant improvement and renewal of its machinery. By these means, without injury to the interests of the hand-wrought lace business, its machinery places the luxury of lace of great beauty and at low price, at the command of all the world."

Although the price of machine lace is not more than one-eighth of that of cushion lace, there never need be any fear of the lessened use of cushion lace, however close the imitations by machinery may become.

The touch and finish of lace made by hand must excel them. The rich are seeking therefore more eagerly than ever the exquisite work of Brussels or Alençon. M. Auguste Lefebre, manufacturer of pillow lace at Bayeaux and Caen, reported in 1860, "that since the exhibitions at London and Paris, the demand for real lace had increased 30 to 40 per cent."

The French were found in 1855 to have doubled their bobbin net production since 1835. Jourdan had begun to make lama lace. In 1856, Dognin had removed his machines to Lyons. Maillet and Oldknow, Bonsor, Keenan, and others were making curtains on Livesey's system. That plan improved is now being used extensively. R. and T. Birkin having taken out an English patent, No. 945, January, 1857, for making embroidered breadths straight across the Levers' machine, on taking steps to patent it in France, discovered that Topham, of Calais, had obtained, September 23rd, 1856, a patent for the same process. More than half the French lace patents are found to be taken out by Lyons people.

Mr. Ferguson, jun. states as follows:

"French bobbin net frames in 1831 were 1000 producing an annual return of £400,000; in 1833, 1200 producing £440,000; 1835, 1585 producing £400,000; 1836, 1600 producing £400,000; 1844, 1800 producing £400,000; 1851, 1200 producing £440,000; and 1856, 1400 producing £800,000."

His remarks upon these figures, explanatory of the different results of the trade in regard to the greater or less amount of the machinery, are valuable. The concluding observations are also deserving of the serious consideration of the English makers of bobbin net at the present moment.

For we are arrived at the close of a year, which, after nearly fifty years connection with the trade, the author does not hesitate to characterize, as one of the most portentous of evil that the English bobbin net business has ever passed through. Without accepting the defects in English management of the lace business stated or implied by this writer, in all the extent to which they might be adversely pressed, yet it would be unwise not to ascertain and grapple with any real evils in order to effect a remedy. The explanatory statement runs thus—

"The comparison of machines and production shews some discrepancies arising from various causes. At first all the machines were narrow, complicated, and slow. They became doubled in width and much quicker, especially when put on to steam power. A difference in quantity sold has sometimes altered the quantities made. The annual value has been greatly augmented by the amount of fancy production. These discrepancies are seen most remarkably in the English trade; where in 1844, there were 512 machines less than in 1836, and those remaining gave £400,000 more returns than in 1835. In 1856 there were 1342 more machines than in 1835 and the returns were doubled. In 1851 the number of machines was more than in 1844, and the production the same. A commercial crisis had sur charged the warehouses with lace merchandise."

The contrast between the condition of the business in France in 1851, when the machinery had been lowered since 1844 from 1800 to 1200, and the returns were £40,000 increased, and that of England, where there were 400 more machines and the returns were the same, though not noticed by Mr. Ferguson, is a very remarkable one. Then follows the depreciatory paragraph to which special reference has been made by us:

"In England they work for quantity and to keep down price. They do not keep up quality nor cultivate taste. Cheapness is a fatal rock; and cheating one another of designs and lowering their quality will ruin any manufacture. Job lots and immense discounts destroy confidence, not in specific articles only but in a trade. Immense production for stock induces crises in the trade, and great vacillations in prices."

A further observation made by this writer we quote, because it concerns an important part of the operations of the lace trade, that of the preparation of patterns, and for the purpose of expressing entire dissent from it:

"We do not agree with those who think English designs are equal to those of France. If an English maker has not a French designer, then he purchases patterns in Paris or Calais. If he have one who remains without refreshing his ideas at the fountain of taste, he loses his first merit in a few years."

The English lace manufacture owes much, but not everything, in regard to design, to Belgium and France. These countries have had three centuries of experience. In much less than one, the progress made in England towards excellence in original designs for every class of machine-wrought lace, has been such, as to render her as independent of foreign supplies of taste as her French neighbours themselves.

Notwithstanding the tone of confident superiority present and prospective in everything but quantity expressed hitherto in the extracts given from French authorities, a manifest difference in this respect occurred in the statements made on the occasion of the Treaty discussed in 1860, which was strongly, yet as it would now seem needlessly deprecated. The following statistical details, drawn from the report of evidence then given, will be read with some allowance on that account:

There were stated to be between 1600 and 2000 bobbin net frames in France, of which 650 were at Calais and 400 in the Cambresis. The number had been lessened, but the Calais ones were wider than formerly, and consequently made an increased quantity. Early in 1860, the price of a 20-qr. was £20 a-quarter or £400; later in the year, from the expectations raised by the treaty, the price became £24 or £480 the machine. The frame-work or carcases of the Calais machines were now made there, but still many of the insides were obtained from Nottingham. Occasionally the entire machine, if on an improved plan, was got from thence as a model by which to construct others. They were worked entirely by men, who earned from 14*s*. to 16*s*. a-week, by two shifts of six hours each daily, women winders gained 7*s*. 3*d*. to 9*s*. 6*d*. and children 2*s*. 4*d*. to 6*s*. 4*d*. weekly. Each machine gave employment to 12 persons in all. The Levers' circulars and pushers were moved by mechanical powers.

A machine making 8 motion net would produce 150 racks a-week. Mr. Bailey informed the commission that the 900 machines at work in the departments du Nord and de l'Aisne produced £370,000 value of goods in the year or about £400 each, of which £212,000 were materials and £158,000 wages and profits. His machines had been put on half work for some time. The average of the weekly production per machine in France was stated to be from 150 to 175 racks a-week, while in England some classes of machines were producing twice that quantity. In 1860, there were no longer any plain nets being made at Calais, these machines (circulars) having been transferred to Lyons and were employed in making silk net. M. Dognin said that he had still in a factory at Calais, but about to be removed, 5 frames making chiefly spotted mohair (goat's hair) net; 9, on with silk spots; 8, mohair laces; 20, silk laces. And at Lyons 7 circulars and 6 pusher mohair or silk laces; and 30 warp machines making silk or spun silk laces. The machines were worth £80 to £480 each. Those of the latter value are equal to any. The wages paid are 3*s*. 6*d*. to 4*s*. a-day to men working in 4 to 6 hour shifts twice daily. Including embroiderers, these 85 machines give employment to 3000 people. The cost of materials in plain or spotted goods is two-thirds the value, in laces from one-fourth to one-third only. He exported nine-tenths of his production to European States and America. M. Dognin said he was "careless as to competition with England, Belgium, Germany, or any where else. They had not been imitated because by the excellence of their patterns, they were beforehand with imitators. They had given up taking out patents, because these only afforded knowledge of

what they were doing and led to infringements." After referring to the introduction by his father of the first bobbin net machines into Lyons, (by which workmen gained £12 to £16 a-week (?) of three or four days labour) and by making Grenadine silk net upon them, founding the bobbin net manufacture at Lyons; he went on to state, "that by the 'tulle illusion' which his father had devised (crea) made the fortunes of plain silk manufacturers at Lyons, and was copied by the English at a much later period." M. Dognin was pressed to say how many plain net machines were then at work at Lyons, and whether they could compete with the English; he did not give a direct answer to this question. "He did not know the entire number of machines, but was able so to work his as to meet the English with success."

The chamber of commerce at Lyons stated there were 400 plain net frames producing £280,000 a-year, of which one-thirteenth part only was exported. They found it necessary to fetch both machines and persons to set them up from England; and that in order to compete, this machinery must be put on to work by steam power. They had 30 machines making imitations of Chantilly and Cambray pillow laces, producing £80,000 a-year returns. There were also 250 warp frames making fancies 'dentelle de Lyon' or 'damassees' returning about £160,000 a-year. M. Baboin of Lyons, a maker of plain silk bobbin net, stated the actual number of machines was 382 in that city, of which 300 were owned by 170 masters of workshops and 82 by manufacturers, but not worked conjointly with the former in workshops. He described the bulk of the 382 as old and so defective as not to be in condition to be worked by rotary power. Wide nets, quillings, and Mechlin nets, were made from these frames; the demand for these articles being suddenly much increased. He complained that the workmen could not set anything right which might be wrong, and stated the production working as they did 24 hours a-day was 220 instead of 350 racks a-week as in England, the machines being narrower also. M. Dolfus-Moussy, manufacturer of fancy silk net at Lyons, stated that 350 warp frames were then making fancy goods in that city. These machines were newly made there and constructed on the best principles. They cost £60 to £120 each. They are entirely employed on silk articles for exportation. The workmen labour ten to eleven hours a-day; and earn now 3*s.* 2*d.* to 3*s.* 6*d.* a-day wages, the rate having fallen within the past year 25 to 30 per cent. The bobbin net hands were gaining 2*s.* 6*d.* to 4*s.* a-day. Ferguson states that in 1862 there were 500 warp circular and other Jacquard lace frames at Lyons.

The Treaty, modifying commercial relations between England and France, still gives a protective duty to the makers of French lace, of from 15 to 20 per cent. In 1861-2, sixty superior wide Levers' machines were exported to France. Having cost from £400 to £800, they were sold at an average of £300 each. The production from them copes with that of England in their markets, and in London also.

Embroidery on white lace net gives a considerable amount of employment in France to needle and crochet workers, "au passe" or "au plume." Thus in Paris rich robes and elegant shawls and scarfs are produced. Furniture embroidery is done largely at Tarrare in window curtains, &c. At Luneville bobbin net is embroidered in every class of articles chiefly by the needle. Fine satin stitch formerly carried on at Nancy, is now prosecuted in the Departments of Le Meurthe, La Mosselle, La Meuse, and Les Vosges. In the latter, the taste and intelligence of the workpeople are combined with chasteness and elegance of design. French embroiderers excel in open works to give variety and effect. The business was until recently rapidly increasing in France, and being domestic employment added to house duties, has introduced much comfort and ease into the circumstances of the majority of those engaged in it. There is usually either a pattern figure worked into the article or piece to be embroidered, or one stamped in outline all over it for the embroidress to follow. This she does either by the tambour hook, or running thick thread by the needle around and through the figure for the outlines and filling it up with fine thread cloth work. In doing this, the piece being stretched on a frame, she sits besides it, placing her left hand under the web at the spot where with her right hand she passes her needle around or across the interstices. The posture is sitting and leaning sideways, and therefore not a natural one. If it were continued through long hours daily, and that for years, as was often the case formerly, it is very unfavourable to health. The witnesses examined by the French Commission in 1860, stated the embroidery work done in France amounted to £64,000 a-year; in Switzerland, £48,000 a-year; and in the Vosges to £160,000 a-year. It was piece work, at which the earnings were about a franc (9½*d.*) a-day.

No great impulse had been given to the spinning of fine numbers of cotton yarn in France, until they had been to some extent substituted for linen thread in the finer fabrics of Cambray and Tarrare. A still further demand for them resulted from their having been suc-

cessfully used when doubled, in 1805, by the cushion lace makers of Buckinghamshire; on learning which, the pillow lace makers of France and Belgium slowly overcame the great prejudice with which the change was met, and at length began to consume them extensively. But to spin them of the requisite fineness, and by careful doubling to secure the requisite clearness and strength, was a very difficult task performed in England, and not without great labour and skill, in which process the French followed at considerable intervals of time.

According to the best information upon the subject, the dates and numbers at which the spinning of fine numbers was accomplished there, were as follows: In 1819, No. 40; 1823, No. 60; 1828, No. 90; 1832, No. 110; 1836, No. 170; 1840, No. 210; and 1850, No. 250. While English fine yarns were entirely prohibited entry into France, they were smuggled in at an expense of 4 per cent., the French spinners putting their own marks upon them, and sending them out openly to their customers. English numbers above 170 were permitted entry in 1834, at a duty of 35 per cent., upon which change the spinners in France rapidly pushed on their improvements. In 1842, at Calais 77,151 killos. of yarn were used, of which 29,048 killos. were French spun, and 47,503 were English. The balance was so far turned, that in 1858, 116,130 killos. were used, of which 97,783 killos. were French and only 18,347 killos. were English. In the Report on Treaty, 1860, it is stated that Calais lace makers then consumed 150,000 killos. of yarn yearly; of which 60,000 killos. were spun at Lisle, under No. 170 and upwards; 60,000 killos. under No. 170 smuggled, and 30,000 killos. of No. 170 and upwards were imported from England. M. Loyer, a manufacturer of Lisle, stated that there were the following spindles for spinning fine yarns:

In 1849 at	Lisle	313,551,	and in 1859	695,430
"	at Roubaix	128,000,	"	217,640
"	at Tourcoing	60,186,	"	157,634
"	at Douay (since gone)	50,400,	"	none
	Total	552,137	Total	1,070,704
	add spindles in course of preparation			200,000
				1,270,704

The 1,070,704 are said to represent a capital of £2,000,000.

The finishing of lace goods adds 20 to 25 per cent. to the cost in the rough state. The report also adds, that France exported at that time 20 per cent. of her bobbin net production.

In 1817 the first eight bobbin net machines set up in Belgium, were introduced by Verbeck Moese, at Termonde. In 1828, there were twenty at Ghent, but they could not compete with the English. In 1834, Mr. F. Washer caused eight to be constructed, and they

have been worked at Brussels until now, making almost entirely three twist net of very fine numbers of cotton yarn, and on which hand-made Brussels sprigs were applied by the needle. In this special article he has succeeded in excelling the English make. He exhibited in London, 1851, this net made from Nos. 400 to 530 yarn. This firm has now sixteen machines. At Malines there are eight. At St. Josse-ten-Voode four, making the same ground. It is not produced in France. One Read took the first twenty bobbin net frames into Switzerland, the heavy standard parts of which were made at Calais by Holmes—Hilton, of Nottingham, supplying the insides. There were eighty of these machines in the Swiss cantons in 1856. In Spain it is said there were 500 'pin' machines at work in 1831, and eighty bobbin net machines in 1856. In Austria there were sixty in 1814, and it was said 500 in 1856. At that time in Prussia and Russia, thirty. Russian black silk Jacquard laces were much admired. In Saxony, fifty or seventy bobbin net machines were at work.

In order to bring this chapter to a close, there only remains the necessary duty of describing, so far as the intricacy and novelty of some of them will allow, various improvements effected of late years in France upon lace machinery, all of them well deserving the notice of the trade at large. They furnish unmistakeable proofs, were that necessary, that mechanical genius and its unwearied development, are by no means confined to the English. These inventions are the more remarkable, as having for their object to produce the very highest qualities and kinds of lace by mechanical means.

Messrs. Maillot and Oldknow are established at Lisle, and also at Nottingham, as fancy lace manufacturers. They were amongst the first to introduce the manufacture of lace looped curtains into France, upon Livesey's system.

James Oldknow had the distinguished merit of devising and carrying into successful operation the plan now universally adopted, of substituting for the guide bars, in use until 1849, steel perforated bars. Having patented this invention in France, it was in 1849 patented in England, and under that protection 1171 licenses were granted by Mr. Edward P. Cox, (the representative of the patentees for that purpose here), to English machine owners for the use of these improved instruments. But when the idea was first introduced to the notice of a large meeting of the Nottingham fancy machine owners, convened for that

purpose, it was very generally thought to be impracticable. Mr. Oldknow having taken the precaution of bringing with him workmen from France, who had practical knowledge with himself of its feasibility, they shut themselves up in a room with darkened windows and locked doors, and put the steel drilled bars into a Levers' machine which was ready there for the purpose. When seen really at work, it was with some difficulty those present could understand, how the bars were so accurately drilled as to work exactly with the corresponding parts of a Levers' machine, wherein the bars must act with entire exactitude in the minute space allotted to them. They had to be so drilled, as to operate with the combs, each to the exact guage. It was necessary therefore to place the holes not absolutely equidistant, but with allowed shades of increased space, according as the holes were more or less distant from the sides of the machine. The heat generated by the operation of drilling and consequent expansion of the metal, had to be got rid of by cooling the bars repeatedly during the process. The only drawback to their use is said to be that they are liable to be affected by expansion and contraction through changes of weather. It is believed that in the whole, nearly 3000 machines have been or are working with this useful invention, resulting in an entire modification of the use of Levers' machinery, lowering its relative cost as compared with its increased range and rapidity of production. The Levers' fancy goods produced by this house in silk laces, Greek insertions, trimmings, and ornaments, are very varied and of first quality. Plate XVI., Nos. 22 and 23.

The following singular origin of the machine about to be described, has been related to us: M. Planchè had a son-in-law, a civil engineer in France, who, accidentally looking at pillow lace makers at work, was interested in their operations, and thought, after reflecting upon what he had seen, that the like result might be obtained by machinery. Without suggestions from any one, he constructed a machine which he put into operation, and obtained a French patent for it. One Laforte with another workman, having been engaged in

its construction at their overtime, made a similar one for themselves, for which they have taken out a patent in England. It is stated, that a reclamation for infraction of rights, has been successfully prosecuted before a French court, by the original inventor. A factory has been erected at Roubaix, in which M. Planchè is now working these machines.

In 1861, the produce of the first of them was sold in London for some time as *real* lace. F. Mennons took out an English patent, No. 2267, for an invention by J. F. Regis Laforte, of Paris, and previously patented in France: "It is for an improved combination of machinery adapted to produce netted fabrics identical in texture and appearance with hand-made Valenciennes, Chantilly, Brussels, and other ornamented hand-made laces. Most of the elements of this combination are borrowed from machines known in textile manufactures, especially from looms used for the production of *tulles* and imitation laces."

"The essential objects to be obtained in the mechanical production of real lace, are: 1st, the means of rendering each thread independently capable of passing from right to left, of changing with one of its neighbours, or of remaining stationary if required, so as to form the twists of which the fabric is composed. 2nd, the means of causing one or several threads to cross a given number of others for the production of certain ornamental effects, in passing alternately above and below each corresponding thread by a single motion either right or left."

These operations are so effectually arranged and provided for by this machine, as fully to justify the report upon it, made by the commissioners in the International Exhibition of 1862, where it was shewn—

"As a machine the most remarkable of its kind, producing an article that the most expert judges cannot distinguish from that made by hand. Having seen it at work in Paris we can attest the fact, that in point of difficulty of execution it presents one of the greatest conquests of machinery, and proves incontestably the possibility of substituting automatic for every kind of hand labour."

M. Aubry had said, in 1851, when pointing out the surprising results then achieved in lace machinery—

"Who knows if some day the lace machine may not become the true cushion lace maker, and its bobbins the real spools worked by mechanical hands and fingers."

If this idea, which was the view entertained by Heathcoat in regard to his *first* patented machine in 1808, be not realized absolutely by the machine now under notice, it needs but little to fully accomplish it. Iron instruments are not human sinews and nerves and joints; nor are machines endowed with the wondrous adaptations and powers of animated beings; yet, to describe the various parts, adjustments, and operations of a machine, even remotely imitating a clever lace maker's manipulation of her threads, as she curiously and almost imperceptibly forms them into those floral and arabesque forms we so much admire, would be quite impossible. Especially is it so in respect to this machine, for it would be absolutely a specification of parts and combination of the most intricate kind without the plates and letters of reference. For a full account, comprehensible by the mechanician and him who would study it for practical purposes, the actual patent specification is commended. A few of the most salient points must here suffice to explain special peculiarities in it.

All the threads are wound upon bobbins, and these are placed in carriages having close resemblance to those in common use. All these carriages and threads are operated upon from the back of the machine by a Jacquard apparatus, selecting carriages either in the back or front comb bars. There are guide bars leading to three comb bars. The latter will do all, as it should seem, that Masson's *later* machine does with five or seven. The middle comb bar may be described as the home of the carriages, and does not move. The back and front comb bars move or shog laterally, and the carriages pass to and fro twisting the threads around each other, or remain at rest, as may be necessary for the pattern. The great peculiarity of the machine is as follows: The bobbins are much coarser than the actual guage of the work when it comes to the work roller. It may be that they vary as 3 to 1. But the proportion may be varied at the pleasure of the constructor of the machine. The work is made in a radiated form and at such a distance as to allow its contraction by concentration of the points themselves, as they approach the breadths of work already made. The lower back and front comb bars are of the actual guage of the machine. They enter the threads at the top of the carriages, and by their concentrated or fan shape, they bring the threads into the contracted space of the intended quality of the work. When brought

into this space, the upper sets of points come into operation, taking the twist and crossing from the lower point bars, and convey them to the work bar. Plate XVIII., Nos. 32, 33, 34, 35.

Each breadth of lace as it is made is not attached to those breadths made on each side of it, but is an independent finished article as if made on the pillow. The breadths go on to the work beam side by side, but at a distance equal to the diminution of the space occupied by the threads at the outer circumference of the fan-shaped arrangement of the lower points. Thus the actual guage may be as 3 to 1 of the space occupied by the work produced.

The space thus apparently sacrificed in the non-occupation of (say) two-thirds of the width of a machine, is compensated, so far as it goes, by enabling the carriages to be larger in that proportion, and thus to receive bobbins holding so much more thread.

This machine works more safely than that of Barton's, in proportion as it is far less delicate in the instruments used; though the principle is nearly allied: of course it is of a better and swifter construction on that account.

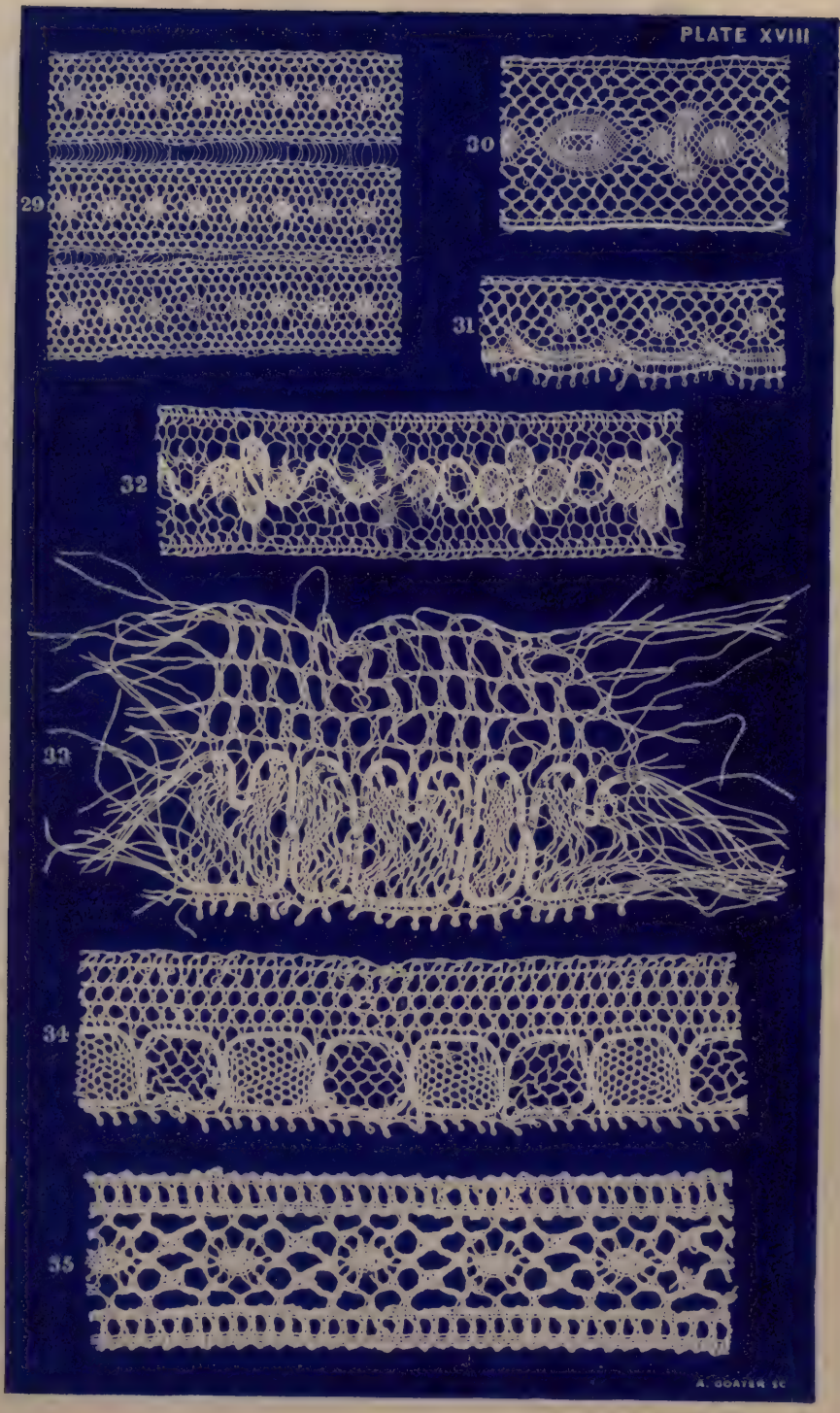
One of the latest inventions approaching to a mechanical performance of the operations which take place in making lace upon the pillow, is that devised by Alfred Masson, at St. Pierre les Calais, and patented here by Mr. Newton in connection with Mr. Shepherd of London. The specification is not yet published. The following particulars may suffice to give an idea, though an imperfect one, of its principal features:

There is no separation of warp threads; all are wound upon peculiarly constructed spools; long, tapering, thin, and, when covered with yarn, resemble a flattened cop. From these the threads are each passed once round a bobbin, and from that carried through an opening at the top of the case to the operations of twisting, &c. This case is eight inches in height, and is an elongated or steeple-topped carriage, inclosing next above the parts necessary for driving and passing through the comb bars the spool with its thread; and above the spool the bobbin is placed with its spring, to regulate, so far as it can, the quantity of thread given off.

The bobbin case has a V groove on one side to fit on V projection on the inside of the carriage frame. The opposite side of the case is bevelled off and held in its place by a spring catch.

The bobbins and carriages work to and fro in combs fixed in

PLATE XVIII



leads attached to the bars. The carriages are moved to and fro by reciprocating catch bars, acting by notches on their under sides by means of springs. The sides of notches in the carriages are at an angle of 45° to the bottom edge of carriages, so that if carriages are held back by any means, the spring catches of the bars will yield, and be withdrawn from the notches without moving the carriages. These are held back by tumbling levers working on centre pins, and are kept to the under side of the carriages by springs. The ends of these bars have projecting catches, which fit into rectangular notches made on the under side of the carriages; when thus placed they prevent the carriages being moved by the bars when the latter advance; but if the tumbling levers are pulled down so as to release the carriages, the latter may be drawn back in the combs by the reciprocating bars.

By attaching the strings of an ordinary Jacquard apparatus to the tumbling levers, the particular levers to be withdrawn for the release of the carriages required to form the pattern may be selected and moved to and fro in the combs, and manœuvred by the catch bars as required for that purpose.

This Jacquard is best placed beneath the working part of the machine. The combs may be divided into five or more sets, according to the kind of article required to be made. Seven sets are shewn in the drawings, four fixed and three moveable; they are mounted on separate bars; the three are capable of lateral movement in either direction, for the distance of one carriage. Any number of comb bars may be used, provided they are alternately placed. If, therefore, selected carriages be drawn by reciprocating catch bars into the combs, they may either be moved laterally in one or the other direction, or left stationary, as the pattern may require their forming any knot or tie or variety of pattern. The catch bars working the carriages are fixed in leads secured to longitudinal bars on each side of the machine. Other bars are secured to the lower ends of curved vibrating levers actuated by pendant rods jointed at their upper ends to bars, and at their lower ends to vibrating bars. These latter rock in their bearings, and are connected at their lower ends by a rod to a crank, or eccentric on the main driving shaft of the machine. These movements of rods and levers impart a simultaneous curvilineal and vibrating motion to the longitudinal bars and catch bars, consequently the carriages and threads may be moved to and fro as required. There are also two rocking bars, each having a series of teeth on which the work is formed. These are lifted and moved forwards as the operations of the machine proceed. These point bars rock on centres secured to the sliding rods, vibrating in unison with the levers; the latter bearing on the edges of a rotating cam shaft, and are actuated by it. A compound movement vibrating to and fro, added to a lifting one, is thus imparted to the point bars. To insure a proper to and fro motion, the levers are forked at their upper ends, and each part of the fork carries a bowl which works against cams within the fork. The shogging motions in opposite directions of the moveable comb-bars are effected by means of a vibrating cam-plate forming part of the vibrating lever, whose elevated and depressed parts actuate the movements each way of these comb bars.

Without pretending to offer any specific and practical opinion as to the successful employment of this ingenious machine, the question presents itself, whether it can be safely driven at such speed as may make it profitable; considering the extraordinary height of the carriage and case, its inevitable vibration with the weight of case and bobbin, and unsteady or irregular giving off of thread from a flattened instrument, which can hardly be prevented by the bobbin spring from affecting the size or shape of the mesh, especially if driven at speed. The height and other peculiar arrangements of this part of the machine, are the result of desire to get as much available yarn as possible, seeing that the supply must all come from the bobbins.

It is designed to produce from this machine shawls or other articles eighty inches in width, not to be distinguished from those made by hand either as to the ground, cloth work, or ornamentation. The selection of individual threads is completely secured by perfect control in their active or quiescent state. The result is an accurate imitation of hand-wrought lace.

A machine for producing simultaneously a back and front fabric for mittens, gloves, &c. from lace and net frames, was devised and patented in England, by J. and J. A. Keenan, of Paris, in 1865, No. 1129.

One half the warp threads, and one half the bobbin threads work in each fabric. Thus, if the machine works a single tier of bobbins every alternate bobbin, (say) the even numbers work to produce the front fabric, and the odd numbers produce the back fabric. The two fabrics are united together at intervals to form tubes by warp threads working into both the fabrics. Thus tubes of desired diameters may be formed of the upper part of the mitten or glove, and these tubes are connected together into a sheet from side to side of the machine. If mittens or gloves are to be produced, it is necessary, after making a sufficient length, to divide at the upper part this tube into smaller ones for thumb and fingers by other warp threads working with both fabrics. The widths may be contracted by greater tension on warp threads, or diminishing the number of meshes. The finishing off of the ends of fingers is given by the hand by knotting or ornamentation. Greater strength may be given to the article by using additional warp threads.

At the moment this sheet is going to press we hear of a patent, just taken out for France and England, for

a machine combining in a very ingenious, and it is believed effective manner, the powers and instruments, including the shuttle, of the weaver's loom, with those of the Levers' lace machine. We have not as yet seen and therefore cannot describe the process or its products. The patentees are Messieurs Rebiere, Pouilly, and Destonbe, of St. Pierre les Calais.

CHAPTER XXVII.

THE MACHINE HOSIERY MANUFACTURE. 1810 to 1835.

During the latter half of the eighteenth century, the productions of the stocking-frame in hosiery had increased in variety, until about the year 1800, when they seem to have attained their highest point, and from that date, by the changes of fashion added to some other causes, fancy hosiery began to decline, and continued to do so for the next forty years. In 1750, hose embroidered by the insertion of threads forming a pattern by hand, while the stocking was in process of manufacture, had ceased to be made. The art of chevening, *i.e.* embroidering by needle hose and gloves already made, had been long practised in France and Spain, and silk goods thus ornamented were brought to England in considerable quantities from about 1700. It was only in 1783 that Mrs. Elizabeth Drake began to cheven hosiery at Nottingham. Plain stockings and those with open work insteps were ornamented with varied and appropriate patterns; on cotton hose glazed linen thread was used; silk goods were embroidered with white silk or dyed in varied colours. Embroidery afforded employment to many workpeople in the English trade for the next fifty years, and then almost ceased. It still prevails extensively abroad. About the year 1780 turned shapes in silk hose went out of use. In 1785, silk velvet pieces and silk brocade pieces figured by employing a boy to draw back the needles, and silk twilled hose, ceased to be made. These extinctions were followed by those of plain and tucked fancy silk vest and silk shag webs in 1790; silk and cotton twilled and brocade vest pieces in 1795. About 1800, there were still seventeen or eighteen different kinds of hose worn as to fashion,

colour, &c. Then the following kinds began to decline and to fall into disuse, viz. silk and cotton non-elastic plated twilled, and silk and cotton plated plain hose; silk narrowed clocks embroidered hose; and warp-vandyked hose in making which 500 frames had been formerly employed. By 1810 silk tickler mitts and silk elastic mitts and gloves, which had required 600 or 700 frames, had gone out of use; as also cotton spider net for ladies' habit shirts, which had employed about 1500 frames, 400 of them working in Nottingham.

These important changes threw a large number of machines back upon the plain hose branch, into which also a great influx of new frames took place. These were the property chiefly of persons not in the trade, who invested spare capital in them, generally in small amounts, and clubs were formed whereby the workmen's savings could be thus invested—all for the sake of obtaining the large rent that was charged so long as work could be found on which to employ them. The trade in all the three branches of woollen, silk, and cotton, soon began to shew signs of distress. The ordinary demand for goods suitable for the country trade fell off, and then the London trade declined, so that by 1810 the situation of things had become gloomy indeed in the midland district. Manufacturers restricted their own frames and stopped those belonging to other people. The workmen, whose condition was now a very trying one, cast about to ascertain the causes of and remedies for such a serious reverse in their employment. They found that a vast increase had taken place in the number of apprentices taught by the masters in the more prosperous times, when hands were wanted to work the greatly enlarged body of machinery. For instance, a father and son in Nottingham had twenty-four; at Hinckley two frame-work-knitters had one hundred between them. In their distress the workmen turned their attention to the powers entrusted to the chartered London company, and sought their intervention for relief. The legally appointed deputies of that corporation were all dead in 1804: others were now appointed, two for Nottingham, and one each for Mansfield, Sutton, and Leake, two for Leicester, and one each for Lough-

borough and Hinckley. Many workmen were made free by paying £1. 13*s.* 4*d.* each, "there being more spirit then amongst the men than since." On their petitioning Parliament for an act to regulate the trade, Alderman Sawbridge recommended them to apply to the company, saying that "if the company were unsuccessful, a Bill should be brought in to protect them, notwithstanding the hosiers' combined opposition." So an action was brought against Mr. Payne, of Burbage, Leicestershire, and tried before Lord Mansfield, for 'colting,' *i.e.* taking apprentices contrary to the company's bye-laws under the charter. Payne, encouraged by the combined hosiers, defended it. The Chief Justice expressed strong opinions against the company's supposed rights, and regretted the claim. The jury however found for the plaintiff, giving one shilling damages. The charter was so far sustained; and Payne, having expended £300, which was all he possessed, was lodged in Leicester gaol, a ruined man. The surplus of labourers complained of was absorbed in some degree by the large demand made by the army during the war, but the relief was trifling, and the excess continued to be an incubus on the trade for many disastrous years afterwards. The men also complained that the long established custom of payment by agreed lists was now laid aside.

In 1802, Dawson's wheels having been invented and employed at Leicester, about 1807 braces and cravats were made by their use in warp frames. The wages gained by making them was one-third higher than by making hose. The demand for these goods went on increasing, so that in 1844 wages still were 20 per cent. above the average; many fancy articles continue to be made of this class, and the trade in them seems likely to be a permanent one. In 1808 German worsted pieces began to be made at Leicester, giving 50 per cent. higher wages than hose. And in 1809, two and one raised cords came into great demand at Leicester, also affording to skilled workmen 50 per cent. higher wages than ordinary goods. In 1810 the hosiery sock trade was begun at Leicester, using woollen and cotton

yarn in the manufacture of these useful articles of constant and increasing consumption. The rate of wages has always been about 10 per cent. above that for hose, as they require a somewhat higher class of workpeople. From these sources some aid was afforded under the general depression.

Several Leicestershire makers of hosiery having shops of frames, removed them to Nottingham, and entered into the finer cotton branch. Two of these, being brothers, established a business long known for excellence of quality produced under the superintendance of one, while the other performed the part of salesman. The latter made his journeys on foot to the London market, and might be seen in town with his samples strapped under his belt and cloak, visiting his customers. This hosier, the last example of the old school, died in 1808, leaving £20,000 to a relative, his successor in the business.

A census of hosiery and lace machinery in 1812, is given by Blackner in his *History*. Some of the numbers are evidently approximative only. At that time there were said to be—

Stocking-frames	in Nottingham		2600
,, ,,	in 74 places	in Nottinghamshire	6685
,, ,,	in Leicester		1650
,, ,,	in 100 places	in Leicestershire	9583
,, ,,	in Derby		400
,, ,,	in 83 places	in Derbyshire	4300
,, ,,	in 16 ,,	Gloucestershire	970
,, ,,	in 3 ,,	Devonshire	38
,, ,,	in 7 ,,	Wilts., Surrey, Berks.	130
,, ,,	in 7 ,,	London, Essex, Kent	137
,, ,,	in 12 ,,	Oxford, Northampton	214
,, ,,	in 2 ,,	Norfolk	22
,, ,,	in 21 ,,	Yorkshire	172
,, ,,	in 7 ,,	Lancashire	75
,, ,,	in 6 ,,	Worcestershire	43
,, ,,	in 4 ,,	Cheshire, Wales	17
,, ,,	in 7 ,,	Staffordshire, Shropshire	46
,, ,,	in 8 ,,	Cumberland, Northumberland	50
,, ,,	in 7 ,,	Lincoln	27
,, ,,	in 5 ,,	Warwick	50
,, ,,	in 38 ,,	Scotland	1449
,, ,,	in 35 ,,	Ireland	974
		Total in the three kingdoms	29582

					Brought forward	29582
Stocking-frames at	24	towns in	France	.	6859	
,, ,,	4	,,	Netherlands	.	520	
,, ,,	11	,,	Spain and Portugal		1955	
,, ,,	10	,,	Italy .	.	985	
,, ,,	6	,,	Germany .	.	2340	
,, ,,		,,	St. Petersburgh		206	
,, ,,		,,	Stockholm	.	30	
,, ,,		,,	Copenhagen	.	34	
,, ,,	5	,,	Armenia	.	260	
						13189
				Total number of stocking-frames		42771

The frames in England were employed, in regard to production at that time, about as follows:

Plain cotton hose		7589
,, gauze		350
,, pieces		250
,, gloves		350
,, drawers and shirts		530
,, sandals and socks		550
,, angola and merino		350
Plain worsted hose		5650
,, gauze		250
Ribbed worsted hose		2750
Plain lambs' wool hose		900
Plain worsted pieces		1500
,, caps		120
,, petticoats, shirts, &c.		300
,, fleecy ,,		110
Ribbed worsted pieces		600
Ribbed thread hose		350
,, cotton hose		750
Plain ,, caps		200
Plain silk hose		1400
,, gloves		320
,, purses		20
Ribbed silk hose		56
British ribbed pieces		1800
Silk spider hose		70
Cotton ,,		340
Silk knotted hose		260
Silk elastic hose		30
Jack warp pieces		30
Double lap pieces		320
Warp-sash and brace		60
		28155
Square lace net	3	
Warp ,,	240	
Point single net	840	
Point double net	200	
Twist bobbin net	140	
		1423
	Total number	29578

A patriarchal frame-work-knitter, James Hutchinson, died in 1813, at the age of ninety-three years; having laboured in the same frame seventy-six years. He was employed by the long-established house of Rawson and Co. fifty-six years. His habits were peculiar; for fourteen years he drank no ale, and never tasted tea; but lived for thirty years on coagulated sour milk, and during the same length of time might be seen working at the same window of the house in Narrow Marsh, where at length he died. He never travelled beyond seven miles from Nottingham.

The rate of wages, which had been raised 2*s.* per dozen by the Luddite commotions and excesses in the trade during the previous twelve months, relapsed in 1812; and produced an application to Parliament to prevent cut-ups being made; or single yarns, whether cotton or worsted, used; or wages to be paid in goods; and to enforce paying by statement lists for the fashioned work, giving fourteen days' notice of any proposed reduction. A bill embodying such clauses passed the Commons, but the appeal was unsuccessful in the Lords, several leading peers opposing it as tending to disunion in the trade. In 1814 the workmen in all the branches entered into a union. The masters offered 2*s.* per dozen advance, and it was given for a time. But the Leicester hands were not hearty in the affair, being met by a combination of masters. Moreover the workmen's deputies discontinued their meetings, being threatened with prosecution under the combination laws. Six hundred Arnold hands contributed nothing to the expences, for many of their families were already reduced to beggary. Three hundred and fifty silk hands at Derby turned out for 8*s.* a dozen advance, but without obtaining any permanent increase.

Public attention was drawn at this period, as in some subsequent occasions, to the reductions in the selling price of goods made in each branch of the trade by manufacturers who purchased goods the produce of materials fraudulently kept back by workmen from their employers, and bought by them at low rates, whereby they were enabled to undersell the honest makers. The evil is one very difficult to cure, because this is

chiefly a domestic business, in which there is a peculiar practice carried on of using soap and other things in the preparation of the materials for work, which may add weight to them that cannot be ascertained. The yarns thus surreptitiously obtained are bought by dealers who dispose of them to the agents of those manufacturers who thus encourage the practice, while they risk their own respectability by the use of these materials. There were more than an hundred and twenty such 'Turkey' merchants, dealers in stolen yarns, in Leicestershire, Derbyshire, and Nottinghamshire; the bagmen, who were numerous in the villages, too often furnishing facilities for these transactions.

The articles of warp plain and ribbed Berlin cotton pieces had been used in very large quantities for pantaloons since 1800. Wages for making them, gave the workmen 25 to 30 per cent. advantage over plain work. But as the fashion changed, they were gradually depreciated in quality, and by 1816 had almost ceased to be used. The price of making fell from 2*s.* 6*d.* to 8*d.* a-yard, and about 1500 machines were put on worsted pieces. The addition of so large a body of machinery to that already employed during the war in supplying the army and navy with worsted webbing, now that the demand was reduced, at once greatly over-loaded the business. Soon the common ribbed trowser pieces, and then the double German ribbed demand failed. This was endeavoured to be met by a reduction in materials and quality, together with lower prices of workmanship. The latter fell from 2*s.* 7*d.* in 1809, to 4*d.* per yard in 1819, by which time this fabrication had nearly ceased.

A small quantity only of 1 and 1, 2 and 1, 3 and 2, as well as broad and royal ribbed cotton continued to be made in 1815. A Guernsey worsted frock for sailors' use, sent as a sample to Coleman and Co. of Leicester, though a difficult article to produce on a machine, was successfully attempted by them, and became a settled article in the trade, by making which about 15 per cent. better than ordinary wages were obtained. The general woollen shirt manufacture has been superadded, assuming at times great importance

and prosperity; but at other times prices and workmanship have fallen very low, as in 1844-5; since then, however, it has become larger than ever. In 1817, the knotted hose trade was taken to Leicester, employing many frames at one-third more than common wages. A change in fashion in 1825, brought earnings in them down from 16*s.* to 6*s.* a dozen. At this time wages had fallen in Nottinghamshire, both for hose and gloves made of sound fashioned work, below the rate of 1812. This induced a turn-out, to which the gentry subscribed, and a large fund was administered in Nottingham to the most needy. The rate of wages was raised to the statement of 1812. At this time the prices of cut-up hose in sale were less than the wages alone, small as they were, of fashioned work.

The year 1819 was a very memorable year in the history of the frame-work-knitters in Nottinghamshire, for the extraordinary severity of the sufferings of the workmen and their families. In their extremity they frequently paraded the town, women and children heading processions, one of which consisted of more than five thousand people. They said that by sixteen to eighteen hours labour they could only gain 4*s.* to 7*s.* a-week; and that for the previous eighteen months they had not been free from the pangs of hunger. These statements created great compassion in the public mind; while the proceeding of the workmen to load carts with frames, and draw them by their own hands from all parts of the county into Nottingham, and deposit them at the warehouse doors of the hosiers, alarmed the authorities. In consequence, six companies of foot and two troops of yeomanry, with ammunition and stores, were brought into the town, and occupied Bromley house. Out of a fund of £3000, three thousand families of stocking-makers were relieved; and by a further sum of £4000 subscribed for the purpose, three hundred families were enabled to emigrate to the Cape of Good Hope. Employment was given, in levelling ground, to those who were willing to do that kind of work.

From the year 1815 wages continued to fall in the hosiery trade of Leicestershire also, till in 1819 the stocking-makers were not receiving enough to sustain

nature, and it was impossible to look upon such a mass of wretchedness without deep commiseration for the sufferers, and a desire to help them if possible. The competition for employment was excessive, and the rate of wages in consequence greatly reduced. The first attempt at relief was to fix a 'statement' list of prices to be paid for work. The agreement to this was far from unanimous on the part of the masters, and the buyers had little confidence that it would be adhered to. Then a turn-out was threatened, to avoid which, the idea of an union of the whole body of workmen throughout the country, for the purpose of affording relief to the unemployed out of their own contributions, with such aid as the public might afford, was largely countenanced by many not engaged in the trade, and by some of the masters, though opposed strongly by others. William Cobbett employed his powerful mind and pen in opposition to the scheme; which gave occasion to the Rev. Robert Hall's celebrated "Reply to Cobbett"—greatly admired for its eloquence and pathos.

"He defended such an union as a means for obtaining a just and natural remuneration for industry; the workman thus obtaining the necessaries of life for himself and his family by foresight and self-denial. He would no longer lie entirely at the mercy of his employer; yet it was not to be confounded with a combination to raise wages arbitrarily: but was a provision for securing practically the terms mutually agreed upon between masters and men. The depression of wages and profits would thus be shared in fair proportion between the two classes."

This distress of the frame-work-knitters, in 1819, was further eloquently referred to by the Rev. Robert Hall, when writing in aid of the fund raising to mitigate it, in the county of Leicester.

"Were the state of suffering, with which we have long been familiar, removed from immediate observation, we could scarcely hear of it without agitation; how much more afflicting to be placed in the midst of it, to feel it pressing on our senses in all directions, without the power of contributing any thing to its mitigation and relief beyond a barren and impotent commiseration! Is there no hazard of contracting a fatal induration by a daily familiarity with indigence which we cannot alleviate, with scenes of woe we can neither remove nor diminish? To go into the house of mourning

is good, since it is adapted to impress salutary lessons; but to dwell in a situation where every house becomes such, is a state to which nothing but utter insensibility can be reconciled."

The proposed union was constituted, and its funds were managed by trustees and a committee of gentlemen who took an interest in the movement. The male stocking-makers in work were asked to pay 6*d.* weekly, or 3*d.* if women and youths. The former when unemployed to receive 6*s.*, the latter 3*s.* a-week. £1,800 was received before anything was paid out. There were about 3000 frames in Leicester, and about 10,000 more in the county. The committee reported at the end of a year, that £6000 had been paid to the frame-work-knitters out of work, of which the hands had themselves contributed £4,400, and that wages had risen 4*s.* a-week for the men, and employment was increasing throughout the country. The effect upon the poor-rates was remarkable. The officers of the principal parish in Leicester stated, "the scheme to be of most decided and unprecedented advantage to all parties." The poor-assessment of the town, which in 1819 was £23,599, fell in 1823 to £11,050, but rose afterwards in 1829, the plan being no longer in operation to £19,512, and was in 1842, the year when Mr. Cort drew up the statement from which these figures are taken, £22,824. In Sileby, the rates in 1819 were £2,205; in 1824, £650; in 1829, £1,092. In the year 1842 the frames in Leicester had become 4000. The distress amongst the stocking-makers of the whole midland district had again become intolerable.

To return to 1821, £6,182 was paid out in relief to the unemployed from the fund in the first three months of that year to 2,172 hands, of whom 1,559 were men, and 613 women and boys. This rapid absorption of the fund, indicating the severity of the crisis, was met by an extraordinary measure. £1,550 was borrowed on notes of hand, to be repaid out of the weekly contributions. Some revival in demand, partly arising from increased confidence of buyers that wages would be kept up to 'statement' prices, gradually set the machinery to work, and permanently relieved the fund. The £1,550 was liquidated out of the workmen's con-

tributions. The fund had amounted to £16,182. Of this the public subscribed £3000, the parishes £2,500, the remainder was contributed by the men themselves.

Some of the Leicester hosiers had joined with the great body of the workmen, in stating to a select committee of the House of Commons, that cut-up work was usurping the place of properly fashioned hose, and that being greatly inferior in real value and use, its effects were injurious to the character of English hosiery, and productive of distress and pauperism to the many hands not employed, whose spirit of independence was destroyed. The committee reported in favour of an experimental bill, prohibiting cut-up work for three years. Such a bill passed the Commons, but was thrown out by the Lords on going into committee after the second reading. A general turn-out was partially commenced, when the principal hosiers of the three counties met at Nottingham, and resolved—

"That they deplored the distresses and privations of their workmen arising from want of demand pressing on their wages so that they cannot by incessant labour obtain the necessaries of life, thus forcing them to the degradation of parish relief. That prices of goods and of labour depend on demand. That the market being overstocked, advanced prices and wages cannot be obtained, to their great loss; and that the workmen themselves lower their price of their own labour. But the hosiers present, resolve that if stocking-makers do not manufacture for themselves and sell their goods so as to lower prices; or parishes turn hosiers, doing the same; or other undersellers pay by truck or otherwise irregularly affect prices, they will adhere to the raised statements then agreed upon."

The statement for Nottingham was issued August 23rd, that for Leicester, September 13th, 1819. Upon raising the fund in Leicestershire designed to help in this emergency, it was ascertained that the number out of employment, included one-third of all the frame-work-knitters in that county.

About this time London became more decidedly the chief depôt for the sale of English hosiery, the capital necessary for holding large stocks in these frequently recurring bad times, being more readily furnished there by wholesale houses, trading more or less independently of the country manufacturers. Nevertheless, as capital accumulated amongst the latter, in a few

years they became merchants also, supplying the home and foreign markets on their own account.

About 1820, several articles in hosiery went out of use. Amongst them plain and knotted silk breeches-pieces, in making which 220 frames had been employed. Also shamoy shaped hand and tickler made cotton hose. This article was still being made in France thirty years afterwards. Next year it was ascertained that there were 1,928 frames at Sutton-in-Ashfield. Each wide one employed two or more narrow ones in finishing straight down hose. 400 machines making twilled, were turned upon spider work. Worsted imperial hose made on Berlin piece frames, now went out of use almost entirely, and wages fell from 8*s.* to 3*s.* per dozen.

A general meeting was held, in 1821, at Alfreton. The distress was again great, and a public subscription for the unemployed was made, upon which a more general strike than any before or since took place; scarcely a dozen of hose was made in the three counties for two months. It resulted in a return to the statement of 1819, for both worsted and cotton goods. The accumulated stocks were cleared off, and a large demand arose for coarse goods. Upon this, at a meeting held at Loughborough, a general further advance was proposed of 2*s.* per dozen; but the decision being postponed, at another meeting held at Nottingham, in 1822, it was resolved to strike, two Leicester deputies only objecting. It was partially carried into effect, and for a time the prices advanced somewhat, but in the main, 1819 rates only were obtained.

The 5th George IV. chap. 96, known as the arbitration act, was passed to enable disputes to be more equitably and summarily settled between masters and workmen than heretofore. By it, tickets of prices mutually agreed upon were made legally binding. It has however been of little use, the men declining to avail themselves of it. There was only one case in the hosiery trade within three years, and the act became obsolete.

Prices had gone down again for stocking-weaving so much, in 1824, that after unsatisfactory discussion with the hosiers, who offered 2*s.* per dozen advance, a great

turn-out took place. This lasted thirteen to eighteen weeks, and caused much suffering. There were great differences of opinion amongst the men, as to the policy of this strike, some of them declaring the majority to be blind to the teachings of experience as to their real interests. The prices given by hosiers were very irregular.

No effort was made to keep up the contributions of the workpeople to the funds of their union in 1824-5, so that although in 1825 new statements of advanced wages were put forth, both in Leicester and Nottingham, they were only paid for a few months. The masters had entered into a combination to resist further demands, when the panic of 1826 came and gave an accelerated force to the declension of prices which had already set in. The following articles had now almost disappeared from the market, viz. tuck ribbed silk stockings, formerly made upon 300 to 400 frames; shamoy shaped embroidered silk hose; silk square net mitts knotted and tuck pressed, made in Nottingham and London from about 150 frames, the men working in them earning £2 to £3 weekly; and plain and fancy tucked silk purses. In 1825 the frame-knit trade appeared in Leicester. Though at first the wages were in favour of the workmen, they were brought down by 1837 to the ordinary level.

The fall in wages throughout 1827 produced such loud complaints, as to induce the masters to agree to an advanced list. Some of them soon began to give reduced rates, which resulted in strikes at various places. But the sufferings from the strike of 1824, caused such a dread of their repetition, that the movement was a very partial one. A new statement of prices was agreed upon in 1830 at Leicester for making woollen goods. The same year cotton Berlin web for gloves, &c. was introduced there, for working which at first the wages were two or threefold those paid for ordinary goods. Warp lace looms were altered to make it. The wages fell from 1*s.* a-yard to 6*d.* in 1845, when half the looms were idle. The average value in Derbyshire for silk frames was, in 1832, £12, and of cotton frames £7 to £8 in Nottinghamshire. The hands in 1833 again

urged complaints upon the House of Commons, in a petition from Basford. The pressure was so severe on the trade as to threaten serious consequences. Their state, and the views they thought necessary for their relief, were clearly and forcibly stated.

"They describe themselves as a large body of industrious and peaceable men, and ask to be protected from starvation in their poor, but to them endeared homes, and from death in workhouses, amidst insult and reproach. They pray for the enactment of a minimum of wages, the abolition of wide frames, and cut-up work, also for an allotment of crown or waste lands to which they might transfer their families, and the repeal of taxes on the necessaries of life." They stated further by their delegates that there were 4000 wide frames making two to four hose at once shaped by scissors, and producing six-fold the quantity of those made by the fashioning frames. These were called 'lamb tails.' And they asked for marks on hose, shewing their size and quality. It was further alleged by them that a United States Boston firm was buying English frames to supply *sound* work. A Leicester petition of the same date states wages to have fallen to one-half the rate of 1814. This it ascribes to the cut-up goods; and says that labour ought to be protected in the spirit of the charter of Charles II. A Leicester deputy proposed "that the trade should be put under the factory act, so that apprentices might get less work and more food, and that goods not fashioned on the frame should be by law sold under the title of 'leg-bags.'"

"The standard size of women's hose is twenty-five inches in length; in 1833 they were often made from two to four inches longer, and of stout yarn, so as to fit men,—other sizes made in proportion." A writer, conversant with the trade, wrote to a local newspaper of that day, making the broad assertion—

"That there is no four-legged animal which could exist a twelvemonth if worked as closely the long hours and fed as poorly as the frame-work-knitter. It would quickly kill off a whole race of horses to keep and work them thus. Yet these people are growing grey under an infliction which only because they are men, and possessing the faculties of reason and hope, they are enabled to endure."

The only part of the trade that obtained an increase was the Hinckley coarse cotton branch. A higher statement was agreed upon this year for their goods only. The three counties union was revived—

"With the view of raising labour to a fair price by peaceable and legal means and when raised to preserve it at that rate, each frame-work-knitter to pay 1*d.* a fortnight or 2*s.* a-year."

As prices for workmanship were as low at this period as at any time between 1812 and 1866, the following table will assist in understanding what the proportions were:—

Taking 'womens dump bound in' hose in several qualities as the standard; the wages per dozen were, in—

	24 gauge.			30 gauge.			36 gauge.			40 gauge.			46 gauge.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
1814:—	0	10	0	0	18	0	1	5	0	1	11	6	2	2	6
1833:—	0	7	0	0	10	6	0	13	9	0	18	0	1	4	0
1842:—	0	7	6	0	10	6	0	14	6	0	19	0	1	5	6

In 1833, there were only twelve frames at work in London, and these were for theatrical uses. Half the frames at Godalming were stopped, as were those at Cork and Belfast, and thirty only left in Dublin.—The fact was well-known to the workpeople, that the writer of these pages had been collecting statistics, shewing the extent of the trade and its prospects, and the numbers and earnings of those employed in it. Their leaders were afraid that their cause might suffer with Government and Parliament by their union, and even that it would be put down. They ascertained that the statistics of both trades, hosiery and lace, were intended for the use of the Board of Trade. A deputation in consequence placed many statements in his hands, which were communicated as desired to Government. The following portions are not without interest, even now:

"From that time the oath on admission was given up, though the form of initiation was still very solemn and affecting. They have no bond but the law of the land, and the moral law of the Bible. They meet at public-houses because most convenient. They expect every man to hold persons and property sacred, and do not use fear as a means of coercion to work or not to work for any master or on any terms. They wish their members to live a conscientious and sober life, and to get instruction for themselves and their families, and to do their neighbours good. They think God made man to inherit the earth. Persons having property and capital should use them for the benefit of their fellow citizens as well as themselves. A workman's property is his labour. They desired such wages only as were consistent with fair profits to theiremployers. But they ought to lay by funds sufficient to prevent needless reductions in wages, and other safe and proper purposes. They were good subjects; and hoped by reforming themselves, their trades and wages, to make this England a paradise in regard to the state and morals

of the labouring class, and by rendering bad government and general misery impossible. They stated Lord Melbourne would not interfere, and Lord Althorp advised them to shorten their hours of labour and production."

The following is a condensed account of the statistics of the English machine-wrought hosiery trade in 1833:

		costs of materials.	wages and profits.	total returns.
		£	£	£
10300	frames making fashioned cotton goods, used	73000	252000	325000
6000	cut-up cotton	172000	383000	555000
9500	fashioned worsted	284000	256000	540000
1000	cut-up worsted	40000	40000	80000
1300	angola	45000	59000	104000
1900	lambs' wool	80000	66000	146000
3000	silk	120000	121000	241000
33000	frames *at work* 1833.	£814,000	£1,177,000	£1,991,000

This annual return was composed of cotton hosiery, £880,000, in which wages were 4*s.* to 7*s.*; and cut-ups, 10*s.* to 24*s.*; worsted, &c., £870,000, wages 3*s.* to 6*s.*; silk, £241,000, wages 6*s.* to 12*s.* a-week. Hands employed 73,000; capital employed, £1,050,000.

At this period about one-fourth of the full wrought work and three-fourths of the cut-up production passed through the hands of bag hosiers to those of the wholesale manufacturing hosiers.

By purchases of raw materials and providing money for workmanship, parishes had occasionally endeavoured to mitigate the sufferings of the people and eventually to lighten their own rates. In a few cases it answered by their holding until good times carried off the stock at fair prices. In general however they grew frightened, and sold at a loss—the usual result of interference with the regular course of trade.

This report closes with describing the stocking-makers as steeped in poverty; ill fed, ill clothed, ill lodged; as physically deteriorated, mentally depressed, and often morally debased. They were easily distinguished by their care worn anxious faces from other handicrafts men.

Mr. Biggs furnished a valuable report to the Board of Trade the same year, upon the Leicester hosiery business.

He stated there were 14,000 frames employed, of which 11,500 were narrow, the earnings on which, at 7*s.* a-week, were £201,250; 2,000 wide at 12*s.*, £60,000; 500 looms at £1, £25,000; giving further indirect earnings to 10,667 at 2*s.* 6*d.*, £66,670 and 2000 at 3*s.*, £15,000 which together with 1,333 employed in finishing at 10*s.*, £33,325; amounted to £401,245 paid in wages to 14,000 hands; added to which materials &c., £600,000 made up a return of £1,001,245, of which £159,400 was exported.

The union committee, seeing no signs of legislation on their behalf, or of further inquiry by government into their state, became impatient, and announced an intended general strike in 1833-4. From this they were earnestly dissuaded, because of the increasing probability of a better demand, which then appeared to us almost a certainty. The hope was realized, for within six months a moderate advance took place in the general rate of wages.

CHAPTER XXVIII.

THE MACHINE HOSIERY MANUFACTURE. 1836 TO 1846.

In the year 1838, the then oldest Nottinghamshire stocking-maker, died in his ninety-fourth year. This fine example of what one could wish every workman should be, was born in 1745, and bound an orphan apprentice in 1755. At that time the charge on journeymen frame-work-knitters, for board, lodging, and washing, was 5*s.* a-week; meat was 1½*d.* per pound, butter and cheese 3*d.* per pound, and wheat 3*s.* to 4*s.* a bushel. Being a swift and steady hand, he was always amongst the last to be stinted or thrown out of work in a slack time, and the foremost to be put into employment on a change for the better. He not only married and maintained his small family comfortably, but saved sufficient money out of his earnings to enable him to build, in 1783, a good brick cottage of four rooms, the land for which and a fair garden by its side, was publicly presented to him and set out for the purpose by the lord of the manor. He lived in it fifty-five years. About the same time that he obtained this quiet home, he was enabled out of the produce of his own labour and that of his only son, then a frame-work-knitter also, to purchase a new frame in which he made hose for the following thirty-five years. It cost him £25 at first, and £3 only during that time for repairs. When he ceased to work, it was disposed of for £10. He attributed this trifling wear and tear to timely repairs, and careful handling of the machine. When he began life, the usual hours of labour were ten, five days a-week, and one Saturday was allowed for taking in work and marketing, the alternate one for gardening and domestic matters. In middle life twelve hours' work was necessary. At its close,

fourteen to sixteen hours a-day scarcely sufficed for obtaining a bare maintenance by those who depended on this kind of labour.

This modest and intelligent workman was much respected for his truthful and upright conduct, and equally beloved, because of the cheerful amenity of his disposition. So much confidence was placed in the accuracy of his testimony, that it was frequently required in matters of boundaries, roads, water-courses, and other legal enquiries, until he had attained extreme old age. Many passers by were wont to stop and admire the venerable man's prolific garden, ornamented with choice flowers, and its trimly cut hedge of many years' growth; and not a few in superior stations of life gave him their friendship, and liked to visit him in his pleasant abode. There the author was taught by him nearly sixty years ago to labour diligently in the art of stocking-weaving, as the source of his livelihood; and there, after an interval of thirty years, he had the satisfaction of hearing him say, with unfaltering voice, when dying, "I have lived in comfort by the Divine blessing all these years under this roof, and am now going to dwell in the house of the Lord for ever." This is an instance of practical effort to perform his duty, shewn by one in the common walks of life, through the exercise of those powers with which most men are endowed, and by habits which all may certainly acquire. These were—diligence, thriftiness, sobriety, handicraft-skill, love of wife and children, kindliness to others, and contentment with his own lot. The consciousness of having endeavoured honestly to fulfil duty, is the only source of real satisfaction in any station of life, and there is no place more fraught with happiness, than the home of such a mechanic as the one we have now described.

The hosiery business was fast approaching the darkest period in its eventful course. Having when describing events in the lace trade mentioned facts, shewing the intensity of the revulsion consequent on the panic in 1837, it is only necessary to say here, that the great distress in the hosiery business was faithfully reported upon after personal enquiry on the spot in that

year, by Mr. Gulson, the assistant poor-law commissioner. Again, in 1840, Mr. Fletcher when reporting upon the condition of hand-loom weavers, gave an account of the stocking-makers, in which their low wages, poverty, and sufferings were related in terms of strong sympathy. An association had been set on foot in Nottingham for ameliorating the condition of the working classes, in consequence of their depressed and partially employed state. The objects proposed were—

"To advocate due protection and encouragement for home manufactures—to collect and diffuse general information upon the trades of the district—to discuss and report upon the rates of wages paid in them—and by holding friendly communications between manufacturers and workmen, to promote mutual confidence and good will, and thereby the interests of both classes, and especially to secure a just and uniform as well as an adequate rate of wages."

At the same time, a new chamber of commerce was organized, with the view of assisting to revive trade. But neither body could agree on remedial measures, and gradually ceased their operations.

We have stated, that all the enumerations of stocking-frames previous to that in 1844, had been confined to those found to be actually at work. The hosiers had an indistinct idea, that the so-called independent frames were numerous, but they were too much engaged in their own business, and had so great a dislike to any inquiry or marked interference, that each was content with endeavouring to deal with the course of events and circumstances affecting his own interests as they arose. There never was a case, nevertheless, in any branch of manufactures, which shewed when the facts were ascertained, more than the hosiery trade, the importance and necessity of enquiries from time to time by competent and authorized persons into its state, the amount of machinery and returns, number of hands, rates of wages, and classes of production.

It should be one of the principal functions of our chambers of commerce, to obtain authentic annual returns, which would serve for the guidance of manufacturers and their workpeople; and being transmitted to the Board of Trade, would show whether the public

interests were being promoted as they ought by the operations of the business. There is no position or species of trade in which accurate statistics can be otherwise than useful, or indeed safely dispensed with. If such had been obtained and fairly dealt with by the hosiers between 1800 and 1810, they most likely would have saved their machinery and capital, with the wages of their workpeople, from the fearful depreciation of the next half century.

High frame rents had then placed two-fifths of all the frames, *i.e.* about 18,000, in the hands of people who had really nothing to do with the trade in any direct form, beyond obtaining rent for them. While the demand was good, the supply of work from these machines not being to be depended upon by hosiers, their influence was injurious to the manufacturers; when the trade fell off, they by their competition for employment, brought down the workmen's wages throughout the whole production, from more than 45,000 frames. As an instance, a supervisor of excise laid out £1000 in the purchase of 200 frames, which in the first instance he endeavoured to let to hosiers; not succeeding, he tried certain bag hosiers, and what these would not hire, were offered to smaller master stockingers. There not being employment for all, what work could be obtained, was in this and such like cases spread out in lessened amounts weekly to the hands, who in many instances were charged full weekly rent for a partial week's supply of labour. It is doubtful if this injustice is not inseparable in a greater or less degree from the system of frame-rents. High frame-rents and excessive charges of other kinds, seem to us not only wrong in principle, but destructive in practice, and the abolition of them would be followed by a real benefit to both employers and their workmen. In this opinion, we are aware, the owners of frames do not generally acquiesce. Possibly the events transpiring of late years may solve the vexed question in a safe and satisfactory manner to all parties.

As regards the diminution in the value of frames, it may be noted, as an example, that nearly forty years ago, in consequence of the bankruptcy of Clark, Mitchell,

and Co., 400 stocking-frames were brought to the hammer and sold for £1,350, or £3. 7*s.* 6*d.* each; 1,170 were sold by auction at Nottingham, in the year 1824-6, for £7 to £8 on an average, and from 1827 to 1832, 2,746 at about £4 each. These 4,316 frames were bought therefore for somewhat less than £5 each on an average, or less than two years' rent charged for their use. It is probable that not less than 15,000 frames changed hands at this rate. That the rent is greatly out of proportion to the second-hand value and cost in repairs of the great body of the machines is plain. The annual outlay by the hosier, including the recruit, does not average more than £1, and, with proper care on the part of hands, it ought not to be so much by one-half. The rent of narrow hand-frames is £2 a-year at least, if at work. An income of £1000 per annum clear therefore, was stated by one eminent hosier, to be derived by him from each 1000 of his frames when employed. This gentleman gave evidence in favour of charging frame-rent, because, by its causing hosiers to give out work in bad times, at the risk of holding large stocks to a loss, the men would be continued in employment, when otherwise they would be set adrift. Notwithstanding the commercial unsoundness of the principle thus enunciated, he was supported in this view by most of the hosiers at Nottingham and Leicester, some of whom employed from 1000 to 5000 frames each, chiefly their own property.

But few new English frames had been constructed between 1810 and 1840. The framesmiths were so reduced in number, and pressed down by dearth of employment, as to induce a part of those who remained to attempt the revival of demand for frames by constructing them for lower prices. The Derbyshire framesmiths published in 1838 the following list of prices:—16 inch 30 gauge, £19; 20 inch, £22 4*s.*; 24 inch, £25 8*s.*; 28 inch, £29 4*s.*; and 32 inch, £34. 16 inch 3 needle 30 gauge silk-frames, £24.

The act 1 and 2, William IV., cap. 37, called the Truck Act, was passed in 1831. Under this statute a question arose, which was most important to the hosiers and their workmen. Frame-rent had been charged by the one and paid by the other for a century preceding, varying in amount from 9*d.* to 3*s.* weekly,

according to the width and gauge of the machine. This had been a growing source of complaint and ill feeling. The amount of rent charged continued the same for the frame, though the price paid for the work made upon it had been gradually reduced, and sometimes full rent was levied when the frame was only partially employed. By custom, the rent was deducted in the settlement of wages. The question naturally arose as to whether this deduction was consistent with the provision in the 'trunk act,' which required that the entire amount of wages must be actually paid to the artificer. A person, named Chawner, sued his employers for £3. 13*s.* 6*d.*, thus as he alleged illegally withheld. The case was tried at the Leicestershire autumn assizes, 1844-5, when the defendants pleaded, that the charge for frame-rent was in principle sanctioned by statute. A verdict was taken by consent for the plaintiff, with a view to a special case being argued in the Court of Queen's Bench: accordingly this took place, and under the direction of Lord Denman, the judgment was reversed, "the rent and charges being according to invariable usage of the trade, which was known to the plaintiff, and he was dealt with accordingly."

The pressure upon the authorities, by whom relief to the necessitous was administered, became so great, that in many unions, as at Sutton-in-Ashfield, amongst others, families were assisted by making up wages out of the rates. In this, the guardians were countenanced by the neighbouring gentry.

In 1844, an important instruction was issued by the Poor-Law Board to the clerks of the Board of Guardians and to the overseers of the poor, to take proceedings against any one paying wages by truck to persons seeking relief. It was high time that the degrading system of furnishing workmen with food on account of wages was put an end to; for so common was the practice of under-masters and bagmen paying by truck before the year 1845, that in eight of the villages in one district, which were visited in taking the hosiery census of 1844, it was found that of eighteen bagmen, only two paid wholly in wages. In Nottinghamshire, more

than two hundred and fifty of these truck masters (as they were called) were enumerated. The numbers were equally great in proportion in the counties of Derby and Leicester. A man grown rich by the practice, hunted with the Quorndon hounds for several years. Subsequent improvement in the trade, public opinion, and the influence of the hosiers who are the ultimate employers, have brought about an entire abolition of the system, so far as can be ascertained.

Other charges besides that of frame-rent have been mentioned. These, which are made by under-masters, are usually for fire, light, standing, winding, needles, and getting out and taking in work from and to warehouses; and have amounted in bad times to an important part of the gross wages to the workman. For instance, a list, published by the Leicester Board of Guardians in 1847, of the nominal earnings of 500 frame-work-knitters, shewed they were in one week £194, from which the deductions were £77, leaving £117, or 4*s.* 8*d.* for the average weekly wages of each workman. The total poor's rates in 1844 for the county of Leicester amounted to £95,315; the shop charges upon the frame-work-knitters to £129,906. An under-master working thirty frames cleared by rent and charges £250; another by sixty glove frames, after paying £75 for repairs, gained £500 in a year—the whole having cost him only £500 for the purchase. These charges for frame-rent and other things were highest in Leicestershire, where the cost of the frames was the lowest, and the reverse in Derbyshire in both respects. The clear earnings for an average week's work, of from sixty to seventy-two hours, on cotton hose, was from 5*s.* for 30-gauge and below, to 6*s.* for 32-gauge and above; cotton gloves, 6*s.* 6*d.* fashioned, and cut-up 7*s.* 6*d.*; cotton drawers and shirts, 7*s.* 6*d.* For silk plain hose 7*s.* 3*d.*, knots 8*s.*, gloves 7*s.* 9*d.* a-week. These figures represent the weekly income of the employed part only of those who worked in about 20,000 frames; the number at work half their time, or wholly unemployed, amounted to several thousands.

Under these circumstances, as to which they could exercise neither foresight nor control, and in which each

year added to their hopelessness and misery, it is surprising that no further demonstrations of general suffering and popular anger than the one in 1842 should have taken place. In that year the working classes of the country proposed a general cessation from labour, until the political charter could be obtained from the three estates of the realm. This caused much excitement amongst them in all manufacturing districts; and, as might naturally be expected, the stocking-makers of the midland district were induced to join in this movement. Any change it appeared to them, must be for the better. Some thousands from the county collected in Nottingham, and great commotion ensued. Several hundreds were arrested for riotous behaviour, who, on quiet being restored, were liberated, and returned to their usual occupation so far as labour could be obtained.

We do not hesitate to affirm that the actual sufferings and privation experienced during the so-called Lancashire famine of 1863-6, were far less than the distress in the midland hosiery district during the interval between 1810 and 1845; where it became a long and widely spread practice to still the cravings of hunger in the adult by opium taken in a solid form, and by children in that of Godfrey's cordial.

These people had been for years at the lowest point of existence, feeding on bread and potatoes sometimes for weeks together. Their furniture gradually disappeared; their clothing could scarcely be held together; and nothing new had been obtained by many families for so long that they could not remember the time. Their dwellings were for the most part filthy and the abodes of discontent and misery. The children had no scholastic education at all.

A framesmith making his usual inspection of hosiers' frames at workmens' dwellings in Nottingham, to ascertain their state, after thus spending a fortnight, found his health had begun to suffer from the squalid wretchedness of their abodes. Thinking to improve it, he went on the same errand into the country, but found the frame-work-knitters there in a still more deplorable state. From the bad air and other distressing influences in

their condition and that of their dwellings, in another fortnight he returned, too ill to attend to his business for some weeks afterwards. This occurred in 1843.

One of the most illustrative cases of the wretched depression of the frame-work-knitters, and its effects upon their habits of thought and manifest hopelessness of improving their condition, and helplessness if they attempted it, came under the eye of the author in one of his visits amongst the workpeople in one of the lower parts of Leicester in 1844. He found a female at work between nine and ten at night; her husband and two journeymen at work above her head up the step-ladder over the kitchen place she was occupying. Her age she stated to be fifty-three; she had the appearance of being seventy; there were bones, sinews, and skin, but no appearance of flesh. She had been the mother of fifteen children, ten of whom, male and female, her husband and herself had bred up to be stockingers. From sickness in a morning she could not work before her breakfast of tea, but laboured at night till ten o'clock, and her clear earnings were about 2*s.* 6*d.* weekly. She had worked the same frame nineteen years, and was making three feet at once to worsted hose. The frame had been "patched up" twice in that time. The rent of it was 1*s.* 6*d.* a-week. The house rent was 2*s.* 6*d.* a-week. It was ill drained, damp, and unhealthy, as were all around it. She was however cheerful, uncomplaining, thankful, and even pious in her manner and speech.

Here was the female frame-work-knitter; the mother of other female stocking-makers, and of sons too—ten in all—added to the numbers of a trade grievously overloaded with labourers ever since they had belonged to it, and without prospect of relief. Her husband was a man of some character and standing, or he would not have been entrusted with four frames. He was one who made charges on his journeymen, as well as paid them to the hosier; yet neither his labour, and the sum he received as a per centage on theirs, nor his poor wife's long hours and trifling earnings, nor, it seems, any other available means or motives, operated to send his children one after another into better paid and more promising occupations. They seem to have had the idea that having

come of a frame-work-knitting stock they must for ever remain in that occupation.

Leicester, Loughborough, and Hinckley suffered equally with Nottingham, Sutton-in-Ashfield, and Derby. At Leicester sixteen firms had become insolvent, and others were closed, the heads of them having lost their capital. Of 2650 frames belonging to eight firms, 955 were idle. Wages for plain hose did not exceed 6*s.* 6*d.* a-week. By making ribbed hose at Loughborough 8*s.* might be gained. At Hinckley half the men only were fully employed at 7*s.* 6*d.* a-week, the rest gained 4*s.* with difficulty. "The wretchedness was too severe to be pourtrayed, and too extensive to be relieved; there never was any previous distress like it." A subscription of £5000 had been raised at Leicester to relieve the work-people; one-third of all the 18,500 frames in that county not being employed. There had been a large body of warp hosiery frames engaged in making upon worsted piece goods; but that branch suffered equally with the rest; the number of frames unemployed was so great as to bring down their price, so that warp looms sixty inches in width were sold for £5 each.

At this epoch of declining home demand for hosiery, the small foreign consumption suffered a severe blow, from the cessation of export of all kinds of elastic and plated hose made with cotton insides and silk outsides. These articles had been sent largely to the West Indian and South American markets for many years. But latterly the competition in the supply had become so urgent as in order to undersell each other, to induce the manufacturers to reduce the size from the standard in length and width. This, added to their slighter quality, entirely discredited their character and destroyed their use. On the other hand, there sprung up a demand for eyelet-hole fancy hose of fine quality, employing about one hundred frames at Hucknall, and about one hundred for coarser quality at Sutton.

A number of frames were put on having ticklers placed on bars; when at work the ticklers all moved at once, and by three or four such motions of the bars in a course, various patterns were made. By using a Jacquard apparatus twenty-eight motions have been put into the work of such machines in France and Spain.

The progressive steps in the history of frame-work-knitting prove that the miseries so long endured by the workpeople in it, were not consequent upon a lack of either energy or skill in modifying, adapting, and improving their machinery. In no trades have efforts been more unremitting, better directed, or, on the whole, more successful. The entire machine-wrought lace trade has, as we have shown, sprung from the stocking-loom. This notion of inertness has arisen from an imperfect knowlege of the peculiar circumstances under which the business of this manufacture has been carried on. From these peculiarities has issued a rate of wages averaging for so long a time a less figure than that realized in any other department of skilled or unskilled labour, though it had not been pressed down by competition with inanimate power, but remained a domestic hand employment; and notwithstanding the success of inventors who had raised up from it and placed beside it the lace manufacture, drawing from it many of the best hands, giving them wages equal to the highest paid trades in England, and from whose ranks have been derived most successful manufacturers. The special causes of low wages weighing on the trade from 1810 to 1840 were chiefly these; the parish apprentice system in earlier years, construction of needless frames merely for rent, middle men, making full charges for partial work, and payment of wages by truck.

The decline in the employment for frame-work-knitters and their consequent distress, drew the serious attention of kind-hearted landowners in various parts of the three midland counties to the consideration of local means for their relief. This was furnished to an important extent by adopting the system of cottage allotments for gardening purposes, thereby giving some employment and useful aid.

The Duke of Portland let land on his estate at Sutton-in-Ashfield for about 600 gardens at 3*s.* per 400 yards, or £1. 16*s.* an acre clear of further charge. John Dodsley, Esq., of Skegby, let about 300 acres in plots of from 400 yards to 3 acres at about £2 clear per acre. Mr. Frearson, of Arnold, let 100 allotments of a quarter

of an acre each. At Loughborough, and in some neighbouring parishes, the workmen themselves by annual subscriptions previously made, hired land in large plots and subdivided them to suit various occupants. Many landowners were encouraged to continue this during the time of distress, by witnessing the marked good effects which it produced, physically, socially, and morally.

When inquiring in 1844 throughout the stocking-making districts, as to their numbers and condition, special attention was paid to their dwellings and gardens. It was found that some cottages which had been built on waste ground by the wayside, and which usually had gardens attached to them, had been taken down, and in several instances the sites added to the neighbouring private estates. But where the workman or labourer had preserved his separate dwelling and plot of garden ground, his means of living had been much increased by it, and the cleanliness and orderly bringing up of his children were of a superior character. This is almost a paradisaical state for the artizan, when compared with that of the 8000 families cooped up in the back-to-back houses of Nottingham; and when once enjoyed, it is to be regretted he should be deprived of it, either by the will of another, or his own lack of self-denying energy.

The changes which were now made apparent in the places where stocking-frames were found, and their numbers compared with those of former times, are remarkable, shewing the almost entire absorption of the trade in the midland counties.

Tewksbury had been an important seat of the manufacture of hose ever since the stocking-frame was set to work extensively in London and its neighbourhood. The number of machines at work there in 1844 was only 380, while 550 were standing still; and wages were so exceedingly depressed, that the scenes of wretchedness witnessed there were such as our correspondent said "he had never seen before, and hoped never to see the like again." The most valuable part of this machinery has, we believe, been since transferred to Nottingham.

The entire stocking machinery in Ireland had now

become limited to 265 frames, nearly half of which were employed in the special manufacture of Balbriggan hose, which still retained their celebrity, and a few in Dublin dependent on the aristocracy and the theatres.

The actual manufacture of hosiery in London had declined so far in 1844 as to employ only 74 machines; 10 of which made hose stout and widened as well as narrowed, which were chiefly for theatrical uses, as were also 4 making the fleecy outside imitations of wild beast skins; 4 made drawers; 22, purses and sashes; 11, foundations for wigs and woollen Welsh wigs; 2, surgical bandages. A few were worked at retail hosiery shop doorways as decoys to customers, like that of the long established and well known Robert Romanis in Cheapside, and the rest worked to orders in Spitalfields, where there was an ancient colony of frame-work-knitters, which had emigrated from the original locality, Bunhill row, in which Lee first placed his machine, and its neighbourhood.

The long continued depression and sufferings of the greater part of the hosiery trade, added to his early connection with it, induced the author to undertake, in 1844, a general census of its machinery, numbers of persons employed, wages earned, and the amount of returns made at that time. The following figures were thus ascertained, and have been generally adopted since as a close approximation to the truth. The errors in the former estimates of machines were at once manifest, and were of the utmost importance, having been confined to those actually at work, and thus excluding the one-third (chiefly of independent frames), for which there was often no work to be had. There proved to be making silk goods in Derbyshire, hose frames 756, gloves 698, total 1,454. In Nottinghamshire, hose 687, gloves 1,409, total 2,096. Elsewhere 223. Thus there were 3,773 frames, using £141,800 raw silk, and paying wages and profits £191,883, making a return of £333,763.—Cotton goods were being made in Derbyshire of fashioned hose on 3,900 frames, cut-ups 255, drawers, &c. 225—total 4,380. In Nottinghamshire, fashioned hose 5,544, cut-ups, &c. 4,547, gloves 849, drawers, &c. 1,500—total 12,440. In Leicestershire, fashioned hose 6,446, gloves 487—total 6,933. Elsewhere, hose 1,070. There were in all 24,823 frames making cotton goods, using £163,000 raw material, and paying £835,700 wages and profits, making a return of £998,700.—Worsted, lambs'-wool, and merino goods, employed in Derbyshire 2; in Notting-

hamshire 61. In Leicestershire, on fashioned hose 7,061, cut-ups 1,798, gloves 923, drawers, shirts, &c. 1,361, fancies 314, making a total of 11,457. In Scotland, upon woollen house 2,365; elsewhere 198. The total frames making woollen goods were 14,083, using £400,000 worth of raw materials and paying wages, frames and profits £823,750, making up a return of £1,223,750.—There were also 86 frames, using £900 worth of flax materials, paying £5,600 wages, &c., and making £6,500 worth of returns. The sum paid altogether for *imported* raw materials was £304,800. For *home-grown* materials £400,900, altogether the cost was £705,780. The sum paid for wages, expences, and profits, was £1,856,933, and the total returns were estimated at £2,562,713. The number of frames employed were 5,836 in Derbyshire; 14,595 in Nottinghamshire; 18,494 in Leicestershire; 968 in other English counties; 267 in Ireland; 2,605 in Scotland—being 42,765 at work, and there were 5,830 standing; so that the entire number in the three kingdoms was 48,595, giving employment to upwards of 100,000 workpeople.

At the time this census was taken, the hosiery machinery had scarcely begun to be gathered into large factories. The number of frames under one roof averaged then rather more than three only, and even now the absorption of narrow hand-machines into large masses can scarcely be said to have more than commenced. In 1844, there were about 15,000 masters and 33,000 journeymen. But the introduction of steam power, with its more regular and easily applied rules and management, is evidently leading the way to a great and very important change; which will be the more easily brought about, by the powerful impelling motive to the working class, of the higher wages gained for lessened manual labour and shorter hours, which always accompany steam factory employment. What an amount of change of local residence, and over how extended a surface such an emigration may operate; to how large an extent it may help to depopulate villages and increase the over-crowding of towns, already too densely peopled for health or comfort or morals; in a word, how much for good or evil, the face of society

in the midland district may be changed by this possible, and, as some think, rapidly approaching exodus of stocking-makers, must be problematical. The question is however not without interest in several respects. That part of it which relates to where the present homes of these workpeople are (the only remaining body of hand loom weaving cottagers), and what was the number of their frames in 1844, will be found in the following tables abstracted from our census. The reader will notice the fact, that the removal of each frame should it take place must necessitate, if not an entire change of place, the alteration of employment and means of living of three persons on an average.

The details as to width, gauge, kinds of work then making, and of what materials, will be found in the original report; to which also the inquirer is referred for information upon a variety of details, which the changed circumstances of the trade now render it unnecessary to recapitulate.

The following is a list of the numbers and localities of stocking-frames in Leicestershire, 1844; viz. at—

Ashby-de-la-Zouch	14	Castle Donington	110
Anstey	215	Desford	163
Arnsby	100	Diseworth	62
Asfordby	6	Dunton	120
Aylestone	76	Dadlington	34
Belgrave	200	Enderby	350
Barleston	114	East Shilton	650
Barkby	35	Fleckney	126
Bagworth	34	Foston	10
Belton	93	Glenfield	50
Burton Overy	20	Great Glen	100
Barrow	210	Gilmorten	200
Blaby	322	Hathern	367
Bruntingthorpe	70	Humberston	22
Broughton, Upper and Nether	20	Heather	23
Barwell	400	Huncote	92
Barsby	29	Hinckley	1750
Burbage	450	Leicester	4140
Cossington	7	Leir	40
Countesthorpe	214	Loughborough	906
Calton	5	Little Ashby	20
Cosby	250	Little Thorpe	107
Croxton, South	35	Lutterworth	90
Coleorton and Griffy-dam	56	Market Bosworth	80
Claybrook	44	Mount Sorrell	258
Croft	54	Markfield	153

Narborough	144	Stoney Stanton	200
Newton Nethercote	10	Stanton under Bardon	49
Newton Harcourt	37	Smeeton	140
Newbold Verdor	60	Sapcote	220
Osgathorpe	24	Thurleston	85
Oadby	350	Thorpe Acre	47
Peatling, Great	30	Thringston	160
Quorndon	188	Thurcaston	11
Queenborough	110	Thornton	22
Ratby	120	Whitwick	423
Rearsby	70	Wykin	10
Rothley	159	Wimeswould	10
Sheepshead	1209	Wolvey	150
Sileby	500	Whetstone	297
Syston	280	Walcote	70
Saddington	34	Wigston, Great	550
Sutton Cheney	15	Willoughby Waterless	80
Sheresby	60	Woodhouse and Eaves	158
Stapleton	23	21 villages amongst them	72
Stoke Golding	206		
Shornford	56	Total	20311

In Derbyshire 6447 frames were enumerated in 1844, at—

Alfreton, Swanwick, &c.	501	Holbrook	152
Ashover	80	Ilkiston	594
Ashford	100	Kirk Ireton	10
Breaston	50	Kilburn	50
Bolsover	5	Loscoe	57
Breckenfield	30	Litton	80
Bakewell	10	Long Eaton	24
Bonsall	143	Morley	15
Belper	421	Milford	37
Breadsall	10	Matlock	50
Borrowash	28	Melbourn	111
Coxbench	56	Normanton, South	147
Codnor	137	Ockbrook	147
Crich and Fritchley	245	Pentridge	6
Cromford	20	Spondon	117
Clay Cross	20	Smalley	150
Chesterfield and Brampton	60	Sandiacre	16
Draycott	26	Sawley	29
Darleydale	20	Taddington	8
Denby	20	Tibshelf and Blackwell	223
Duffield	151	Wingfield, South	250
Derby and Little Chester	700	Wessington	100
Eaton, Little	24	Wirksworth Dale	10
Higham and Shirland	110	5 villages amongst them	16
Heage	29		
Heanor	722	Total	6447
Horsley-Woodhouse	330		

And 16,382 frames in Nottinghamshire in 1844, at—

Awsworth	10	Hoveringham	45
Annesley	5	Kirkby Woodhouse	501
Attenborough	27	Keyworth	78
Arnold	1397	Lenton	23
Beeston	275	Lowdham	94
Bingham	58	Leake, Great	119
Bramcote	33	Lambley	381
Brinsley, Kimberly, &c.	553	Mansfield	821
Bradmore	34	Mansfield Woodhouse	194
Basford	518	Nottingham and Sneinton	3490
Bulwell	606	Newark	6
Barton	10	Normanton-on-Soar	10
Blidworth	93	Oxton	56
Bridgeford	52	Orston	5
Burton Joyce	106	Radford, Old and New, and Ison Green	775
Calverton	409	Ruddington	343
Costock	30	Rempstone	12
Cossall	9	Sutton-in-Ashfield	1968
Claythorpe	67	Skigby	143
Carlton	589	Shelford	10
Collingham	6	Screveton	12
Cotgrave	20	Selston and Bagthorpe	191
Chilwell	77	Stapleford	33
Eastwood	166	Southwell	120
Epperstone	30	Sutton Bonington	110
Farnsfield	10	Willoughby	15
Gedling	12	Woodborough	191
Gotham	87	13 villages amongst them	25
Gunthorpe	59		
Hucknall Torkard	973		
Hucknall Hustwayte	290	Total	16382

It was estimated that there were in addition the following frames in England:—

London	74	Northstoke	12
Canterbury	6	Twining	30
Chacomb	25	Winchcombe	10
Middleton Cheney	24	Exeter	8
Dobcross	12	Godalming	102
Huddersfield	6	Feversham	10
Leadgate	10	Flewer	6
Wakefield	40	Barnsley	6
Manchester	10	Halifax	6
Stafford	6	Leeds	6
Kendal	6	Saddleworth	15
Alnwick	6	Liverpool	6
Loseby	7	Birmingham	10
Deerhurst	10	Berwick	6
Tewksbury	380	Wooler	12
Ditto standing	550	Lincoln	6

Nuneaton	10	Woodchester	12
Gloucester	6	Various other towns in which	
Leigh	35	are 4 or less	48
Northleach	20		
Pemmerton	12	Total	1572
Thurley	20		

In Ireland—

Belfast	35	Cork	10
Coleraine	12	Drogheda	6
Dublin	44	Inneskillen	12
Dungannon	6	Lisburn	22
Lurgan	8		
Limerick	10	Total	265
Balbriggan	100		

In Scotland—

Hawick and vicinity	1200	Selkirk and vicinity	128
Dumfries ditto	500	Jedburgh ditto	60
Edinburgh ditto	150	Of these not at work in vari-	
Glasgow, Kilmarnock	280	ous places there are 620	
Perth	108		
Langholm	92	Total	2605
Denholm and vicinity	87		

The influence of the publication of this census was considerable: but the appointment in 1845, of a commissioner, Mr. Muggeridge, to make an enquiry, was in consequence of the following petition, signed by upwards of 25,000 frame-work-knitters and presented to the House of Commons in 1843, which, on behalf of the workers of frames in all parts of these realms, humbly sheweth—

"That your petitioners are suffering severe privations from the low rate of wages to which they have been reduced when employed; and the frequent periods in which your petitioners are out of employ, are greater in extent than any other body of workmen similarly situated with regard to steam power; which sufferings your petitioners attribute to the want of protection for labour, by which we are left at the mercy of the unprincipled and competing employers, which system has extended itself through all the branches of this trade.

"That your petitioners have fully considered all those evils and from which your petitioners without legislative interference can never be relieved. That your petitioners are aware of the great increase of the people, while at the same time the machinery in our trade has but slightly, if at all increased; from which circumstance we beg to remind your honourable house, from the reduced price of labour a vast number so reduced are deprived of the means of consumption; while at the same time a spurious mode of manufacture has been introduced, by which means the productions in many articles have been increased twenty-fold, thereby throwing out of employ a great

number of workmen. We your petitioners pray your honourable house to grant a committee to inquire into the allegations set forth in this petition. 1st. As to the present low rate of wages given for making hosiery, and the causes of such depression, and to provide a remedy. 2nd. As to the consequences of the fraudulent making of hosiery by the want of fashion and other frauds; and such hose being made three, four, or five at once, and to restrain such practices. 3rd. To inquire into the enormous exactions of frame rent and other excessive charges, especially full rent when full employment is not given, and to limit the rate of frame rent upon the same principle as usury is restricted. 4th. And we further pray that foreign hosiery may be prohibited importation into these realms, until foreign states will allow the importation of English hosiery. 5th. We also pray for an increase of punishment for paying by truck, by imprisonment, and for a better method of enforcing the law by putting it on the same footing with other misdemeanors as a felony. 6th. And that hosiers and manufacturers, be required to deliver out tickets with their work as to the price given, and the quantity of work required, and making it penal for master stockingers or bagmen taking out hosiery to manufacture, not shewing their journeymen such tickets when they deliver the material to them to work. 7th. And whereas a charter was granted for the protection of the frame-work-knitters of these realms in the year 1663, but as of late years no notice has been taken thereof, we pray your honourable house to revive those protections, and if found insufficient for our protection, we further pray, 8th. And humbly implore your Honourable House, to enact a law empowering the crown to appoint a commission in case of dispute between employers and the employed in the manufacturing districts; to fix and regulate wages; and to make general regulations for the guidance of masters and workpeople, subject to the revision of the Privy Council. And your petitioners will ever pray.

(*Signed,*) BENJAMIN HUMPHREYS, &c. &c."

Both prior and subsequent to this petition, communications were made to the Board of Trade by representatives in Parliament for the counties of Leicester and Nottingham, and other influential individuals, strongly pressing for an inquiry into the premises. The commissioner being appointed, fixed on twenty-two towns easy of access to every place in the three counties, as centres for his inquiry.

Having taken a large body of evidence throughout the trade upon the petition, Mr. Muggeridge thus in brief concluded his report upon it:—

The evidence established the following points, viz.:

1st. That though the system of paying by truck had been greatly checked, it was still carried on indirectly to a great extent by employers who combine provision shops with their operations in manufacture, but whom the then present law (1845) had not been able to reach.

2nd. That although there was considerable diversity in the condition of frame-work-knitters, at different seasons, and in different branches, yet they were, as a body, in a very depressed and distressed state, from the very low amount of their ordinary earnings.

3rd. That this arose from the disproportion existing between the supply of their labour and the demand for it; the latter having been usually deficient, and at all times very irregular, while there was a constant tendency in the former to increase and none to adapt itself to the irregularities or the amount of demand.

4th. That this excess of supply arises primarily from the accessibility of this trade to the unemployed of other classes and from the facility with which a knowledge of the trade may be gained especially in the common branches.

5th. That these facilities admit of competition of women and children of which they largely avail themselves; and the natural consequence is to reduce wages generally by an undue augmentation of numbers, especially the wages of adult male knitters, by lowering them to the standard rate of such competitors.

6th. That this excess of supply is much encouraged by the system of frame rents and the long recognized custom of heavy deductions from wages; which make it the interest of employers to spread work among a larger number of workmen than is necessary to its performance—a practice greatly facilitated by superabundant machinery created and brought into the trade, by other than the legitimate employers in it as profitable investments of capital induced by the customary exorbitant rent of frames.

7th. That no permanent or general improvement in the condition of the frame-work-knitter can be looked for but by a diminution of their numbers proportionate to the existing demand for labour, or such an extension of the manufacture as would largely augment the amount of employment. The first of these means is in the exclusive control of the workmen themselves; and can only be produced by abstinence from early or improvident marriages, or by bringing up their families to other occupations—results only to be expected from the slow operation of improved moral cultivation.

8th. That an extension of the manufacture is most likely to be attained by the improvement of which it appears susceptible in the manner of conducting it; by a more judicious appropriation and division of labour, and whereby the cost of production would be diminished; and by an increased application of taste and skill, in the designs and patterns of the articles manufactured, especially in the fancy branches of the trade.

9th. That an improvement in the quality of most of the goods manufactured is apparently as essential to an increase in the permanent demand, as it will probably be to the maintenance of the manufacture even at its present extent; the evidence tending to establish, that the spurious qualities of a large proportion of the goods made, are calculated to lower the character of the manufacture both at home and abroad.

Though the commissioner was decidedly unfavourable to the continued manufacture of cut-up hosiery, yet much evidence was given by some important wit-

nesses in its favour; founded on its low price and great usefulness in newly settled countries, acting as a pioneer to the use of the better fashioned stockings themselves. And it is remarkable, that though not visibly connected as cause and effect, yet this was the time at which the round frame began to be extensively brought into operation, and the trade in cotton and worsted goods in every department exhibited a new and vigorous activity, with advances in wages and prices. The trade has been improved contrary to the expectations of the petitioners, without any direct legislative interference. But no doubt the commissioner was right in his conclusion, that the trade could only be permanently and securely based on the production of sound articles in materials and workmanship.

Mr. Muggeridge having reported that the interests of all engaged in the trade required the change, since the year 1846 the question of gathering the hand-machines into large factories has been much discussed. We did not at that time see reason for deciding that in order to their working efficiently, so as to secure good work, adequate wages, and reasonable profits, the machines and hands must be subjected to the automatic system which governs the arrangements and operations of a factory. Since then, however, an entire change has been brought about in the relative position of the employers and employed. The demand for goods has for some years been beyond the power to supply them. This has partly arisen from increased consumption. But it has been a consequence also, of the well-known fact in manufactures, that as wages increase, less work is done; especially, when the time devoted to labour is simply controlled by the will of the workman. This consideration may at an early period become one of such importance, as to bear strongly on factory, as contrasted with domestic employment of machinery. Then there is the further fact, of a marked yearly increase in foreign competition. How far this may be carried is dependent on a diversity of circumstances, some of them of a kind that may be in some degree anticipated and measured; others contingent on home and foreign political events.

The small proportionate quantity hitherto consumed and produced, shews there was room for a very large increase of the home consumption of hosiery. The same may be said of our foreign exports. Novelty in design and beauty of execution, was not attempted by more than four or five houses during the first half of this century. But about 1845, successful efforts begun again to be put forth by many Leicester hosiers, to introduce greater variety of colours, styles, and materials, into a multitude of articles so devised as almost to command a sale. Thus, hosiery has been made increasingly fashionable. It is worn so as to be more seen, and contributes its share to an elegant costume, furnishing various attractive articles of female attire. In 1845, Mr. Biggs stated, that 1,300 frames were already employed at Leicester in making new and tasteful articles. The number is much larger now, and is increasing both there and at Nottingham. This for a variety of reasons, is causing the accumulation in factories of machinery to be worked by power. Mr. Collins, of Leicester, shewed at that time, that steam could be applied to round frames. Charges for rent, standing, winding, and other things, were made amounting sometimes in a week's work on these frames, from 7*s.* to 9*s.* 6*d.* a-week; and the net earnings at that time by youths of sixteen or eighteen, were 10*s.* to 16*s.* a-week. At Messrs. Harris's factory, where fancy goods were made, the earnings were about £1 a-week. This house secured secresy as to their production by this inclosure of the machinery.

A meeting was convened at Nottingham, in 1845, at which it was decided, by a majority consisting chiefly of the hands working on cotton and silk in Nottinghamshire and Derbyshire—(the Leicestershire delegates dissenting on the ground that, "the resolutions were behind the age, and were moreover impossible of execution")

"That parliament should be applied to for an act to establish a minimum of wages; to authorize the seizure and destruction of 'cut' goods, *i.e.* those fashioned by the scissors and sewn up; the prohibition of importation of foreign hosiery except on terms of perfect reciprocity; and finally, the re-establishment of the authority of the London frame-work-knitters company throughout the stocking manufactures of the three kingdoms."

The Leicester part of the trade, at a meeting held in March, agreed upon a petition, which was well drawn up, asking—

"That sound and cut work might be stamped before sale so as to distinguish them to the eye of purchasers. That all charges for frame rents and expenses in diminution of their earnings might be entirely abolished. That all work should be given out accompanied by tickets descriptive of kind, quality, and price of the labour, and should be paid for accordingly. That local boards or courts of conciliation composed of masters and men should be established on application to government made from time to time, having for their object the conciliation of differences, the adjudication of small sums in dispute, and vindicating the law in local matters of trade with such other powers and functions as may be attributed to them."

This meeting also decided on the raising of a fund to enable the men to resist further reduction of wages.

In 1846, Sir H. Halford introduced a bill in conformity with one of these requests—

"To require manufacturers to deliver tickets on giving work out to the men specifying the particulars as to the kind of goods to be made and the prices contracted to be given for the work, of which these tickets were to be evidence."

Sir Henry succeeded in getting this act passed. It was soon found that it would be impossible to carry out its provisions; and that if practicable, it would be of no real advantage to any of the parties interested in its execution.

In 1847, Sir H. Halford brought into the House of Commons another bill, entitled "A bill to repeal an act for making further regulations respecting the tickets of work to be delivered to persons employed in the manufacture of hosiery in certain cases, and to make other provisions instead thereof, and to make further provisions to secure the wages of persons employed in the manufacture of hosiery."

"1. Its preamble states it to be expedient to abolish the Ticket Act, and to give more efficient protection to workmen in every department of the trade. 2. The old act to expire on 1st September, on which day the new one to come into force. 3. The interpretation clause limits the term 'manufacturer' to any person furnishing material to be wrought into hosiery goods, to be sold or disposed of on his account; 'agent' or 'servant,' any one acting for and in the name of the manufacturer; 'workman,' any one by whom the materials furnished are to be actually wrought into hosiery. 4. Declares the practice of receiving materials by intermediate parties, and em-

ploying workmen under them to convert the same into hosiers' goods, to be objectionable and ought to be abolished; and enacts that no one, except the manufacturer, being the real and absolute owner of the materials and interested in the sale when wrought up, shall give out work, employ workmen, or enter into any contract for that purpose. 5. A partner may act for a firm, make a contract, and give out materials. 6. An owner may act by an agent or servant whose acts shall bind the principal. 7. Every manufacturer of hosiery shall, on delivering out any materials to be wrought up, whether on his own premises or elsewhere, enter in a book or books to be kept by him for that purpose a statement of the particulars of agreement between him and the workmen, by whom such materials are to be wrought into hosiery goods; such entry to specify names and places of abode of workmen, and be in form in every respect and particular of schedule annexed, and be signed by the manufacturer or his agent. (The schedule for stockings requires twenty-three columns of particulars besides signatures; for socks, sixteen columns; for gloves, seventeen columns; for shirts, sixteen columns; for caps, ten columns; and eight columns for any other description of hosiery). 8. Inflicts penalty of £5 to £20 for contravention of any thing provided in the act on proof before two justices, whether as to contracts between manufacturers or smaller masters, or non-inserting, altering, or obliterating particulars of contracts with workmen as ordered. 9. Books of particulars of these agreements to be kept at the manufacturer's usual place of business; and any workman being or having been within fourteen days in his employ, may apply for and obtain inspection of them, and may copy any entry therein at suitable times. Hindering or refusing such inspection or copies, incurs a penalty of £5 to £20. 10. In case of dispute this book to be produced, and the entry shall be evidence respecting the particulars contained in it. 11. Except where the dispute arises from alleged imperfection of work, when the piece of work in question shall itself be produced; or if not, taken to have been well made. 12. Makes the wages contracted for, a debt to be paid without any deduction whatever. 13. Declares that frame-rents are unjust to workmen, and have given rise to many evils—therefore, ought to be abolished; and goes on to enact that, no person shall let on hire any frame to any workman, or take from him any money, rent, gain or profit, or deduct from his wages on account of his renting, hiring, or using any such loom, frame, or apparatus for making hosiery. 14. Enacts penalties for breach of the preceding clause (sum left blank); states fifteen to eighteen forms for legal procedure, and gives penalties to the crown. 19. Declares no removal by *certiorari* allowable, nor any conviction to be invalid for want of form; nor any but special damage recoverable in case of any irregularity in proceedings.

This proposed Act was of so extraordinary and sweeping a character, as to cause much discussion at the time, and though the state of things as to wages is widely different now to what it was then amongst the body of frame-work-knitters, yet independent frames,

frame rents, charges, and intermediate agents remain; so that these grounds of difference, and, in the event of adverse circumstances in the trade, of discontent, present subjects still for unprejudiced consideration.

At the time, the following objections were made to the proposed enactment:—

"It abolishes frame-rent, but does not provide for securing the owner's right of property in and use of frames, as is done by weekly frame-rent, and his payment for the larger repairs.

"It does not state who in future is to pay these larger expenses, nor deal with the question, Who is to compensate the owners of independent frames for this legal destruction of the value of their property?

"It makes every workman or workwoman independent of any one but the hosier. All journeymen and even apprentices are to become their own masters. A hosier could not give out work to a husband for his wife, or to a parent for his child. No exceptions are contemplated; the object being to get rid of unjust charges and every kind of intermediate agency at any cost. No one is to make a bargain for a working stocking-maker but him or herself. The hosier may employ a paid agent, but the workman must appear in person, and be dealt with individually by a separate agreement, both as to money and materials—a thing impossible.

"Will the hosier thus increase the number of his accounts, or entrust a frame and materials to every stocking-maker on his own account? The chief places where materials are given out, and stockings taken in from the workpeople or their agents, are Nottingham, Sutton-in-Ashfield, Belper, Derby, Loughborough, Leicester, and Hinckley. By the bill all the 40,000 men, women, and youths must waste their time, strength, and money in going to these places, instead of three-fourths of them staying at home to work in the frame, clean the house, work in the garden, or otherwise profitably and healthfully employ themselves. At that time there were 16,280 frames in Nottinghamshire placed in 5,200 shops. The shopmaster only attends the hosier's warehouse. Besides these, the bill would oblige the remaining 11,000 workpeople to travel every year, chiefly on foot, each 400 miles on an average, to visit warehouses already overcrowded, incurring the temptations of the town as well as the expense.

"The book containing particulars of agreements is to be open for inspection, and may be copied and published for aught that appears in the bill. This cannot be fair dealing with an employer's business.

"It is remarkable that, *under this bill no workman could incur any penalty.*

"The direct and necessary result of this bill must have been to entirely break down the domestic character of this manufacture, spread as it is over nearly every open parish throughout the three midland counties; to bring twenty to thirty thousand families into the larger towns, and place the frames in factories. This may, in time, be found necessary; but as it must involve the removal of at least 100,000 persons, would require much caution in the process."

To these adverse remarks, the supporters of the measure replied—

"That the clause allowing the masters to employ local agents, who could enter into binding contracts on their behalf direct with any workman, was sufficient for all necessary purposes of trade; and that a workman has an inherent right and direct interest in making engagements with principals or their servants. Many workmen were already thus directly engaged and employed; and it would be greatly for their advantage if all were so. The men are employed under the prevailing system in ill-ventilated shops, serving in many cases as sleeping rooms, workshops, sculleries, kitchens, dining rooms, and even rabbit houses: where the children are compelled to inhale impure air, and to witness every kind of indecency. The present is a system that encourages vice, robbery, and immorality. The men are unjustly dealt with, and in return retaliate by disposing of the materials, and even sending mere babes to the accursed bagmen to sell the yarn belonging to other people. Under the new system the men are not only better in their social position, but their mental and moral qualities are higher. They get more steady employment, and are not subject to many inconveniences of the existing system. If there are to be middle men, they ought to be made by law responsible to the hosiers as to their masters, in carrying out engagements made on their behalf with the workmen.

"Frame rents impoverish the workpeople by bringing down wages to an unnatural level. Besides, if we are to believe the evidence given by the manufacturers on Mr. Muggeridge's enquiry, the prosperity of the trade does not depend on the profit received for the making of goods, but from exactions made from workmen's wages after being agreed to be paid for at a certain rate per dozen. In every trade where direct deductions are made from wages, the people are in poverty living on the charity of ratepayers, and dragging out a miserable existence, while their employers are growing rich. In factories, more expensive machinery is employed, yet none of these charges on the workpeople are made. Besides, in many factories 1,000 to 3,000 persons are employed, yet the whole of these deal directly with the manufacturer through his servants. Surely no one can assert that the employer of 100 cannot do the like. We conclude in the words of Mr. Muggeridge, 'that frame-rents tend to create surplus supplies of goods, acting together with the long recognized system of heavy deductions on one pretext, and another from wages making it the interest of employers to spread work among more workmen than are necessary to its performance—a practice greatly facilitated by superabundant machinery, brought into the trade by others than the legitimate employers as profitable investments of capital through the exorbitant rent of frames.' This bill does not confiscate property: it is protected by 6th and 7th Vic. And are the masses and rate-payers to be ruined, that a few speculating men may receive exorbitant rents; and the trade be injured, that they may live at the expense of the community?"

There were those who for years had seen and deeply deplored the difficulties and sufferings of frame-work-

knitters, and had expressed their sympathy by devoting time and money to the advocacy of a public and general effort to raise them in position and increase the rate of earnings: first, by creating a fund for the purchase of independent frames; second, the consentaneous abandonment of frame-rents; third, abolishing all shop and middle men's charges, except as allowed by a recognized and reasonable tariff; and fourth, by making it illegal for the bagman to pay less wages for the work than he received it out at and was paid for it from the warehouse, of which, in all points, he must be considered the responsible agent when giving out and taking in their work.

Men of business, having prognosticated, as the event proved rightly, that the 'ticket' bill would fall into disuse of itself, could only see in this effort at trade legislation, another instance of the danger of important and difficult legislative matters falling into over-sanguine and inexperienced management.

A minimum of wages to be legally established and enforced, is still thought by the great majority of workmen to be not only right and desirable but feasible, and if withheld, that it would not be by the force of reason and experience brought against it, but by the strong hand of power.

There are many in other classes, however, who are true friends of the working people, yet agree with most political economists in denying the right or policy of interfering with wages further than to enforce legally the performance of any contract, by requiring the stipulated labour on the one hand, and the due payment for it in the current coin of the realm on the other, and that such contracts should be freely made on both sides. Besides, if a minimum could be established, it must include day and piece work; that of the young, the full grown, and the old; the agricultural, domestic, mechanical, and distributive. The idle, stubborn, inexperienced, and awkward, must in fact be paid out of the funds resulting from the labour of the acute, diligent, well-trained, highly skilled operatives.

On the other hand, discussions with a view to arrangements between even bodies of employers and workpeople,

as the basis for fair and equitable rates of wages, stand on very different ground, and might prove beneficial in facilitating satisfactory individual contracts; especially if sanctioned and ratified, after due enquiry, by boards of arbitration and conciliation. The publicity thereby given to these matters would operate generally to establish and sustain just and adequate scales of wages, and prevent attempts at extravagant and dangerous advances, more than any Act of Parliament that could be devised, and which it would be possible to enforce.

CHAPTER XXIX.

THE HOSIERY MANUFACTURE. 1847 TO 1867.

COURTS of conciliation, arbitration, and regulation of differences arising out of manufactures and trade, have been often proposed and discussed, and sometimes brought into operation. These should be local, cheap, frequent, and final; and so constituted as not to impede the free and profitable employment of labour, skill, and capital in trade. Such courts were established by law in France in 1806, and have been, with some modifications, effectively continued to the present time throughout the empire, under the name of "Conseils des prud' hommes." Their functions extend to every question that can arise in manufactures and trade, except that of fixing a rate of wages; which however, when agreed upon between employer and employed, they can enforce; and in the fulfilment of their duties they have exercised a most beneficial influence. In the ten years from 1830 to 1840 they had 135,730 cases brought before them; of which 128,319 were conciliated, 3513 were withdrawn by consent, the councils pronounced 3881 judgments, against which only 155 appeals were made. Later statistics exhibit a constantly increasing area of operations with equally satisfactory results.

It is not pretended that such courts would be in every particular suitable for England. Yet the principles and modes of operation embodied in their constitution, are deserving of the greatest publicity with a view to serious consideration, especially as the subject has been under inquiry by committees of the House of Commons, and is now one of several cognate topics referred to a commission for full enquiry. An abstract is therefore given of the French laws, as translated by

the present author, in 1835, and since circulated by frequent republications, parliamentary and otherwise:—

"These local trade councils are established in order to hear, conciliate, arbitrate and settle all disputes arising in manufactories and workshops between merchants, manufacturers, masters, clerks, overlookers, journeymen, or apprentices, or each other, as to any employment whatever; thus any agreements and contracts which relate to manufactures or handicraft labour may be submitted to the judgment and decision of persons of competent knowledge, to hear and decide upon them; but they shall have no other jurisdiction whatever, except where statements of facts are required by ordinary tribunals. They are to repress insubordination in manufactories and all serious misconduct of apprentices. They are also to ascertain and state where necessary for the guidance of the superior courts, the amount of loss by neglects, breach of agreements, unfaithfulness, and thefts committed in workshops by those employed in them.

"To guard property in patents, marks, patterns, &c., and to punish those who counterfeit or usurp the same; an appeal is however open to the tribunals of commerce in these cases.

"To give information to government from time to time, of the prosperity or decay of each branch of industry and commerce.

"They shall be composed of merchants, manufacturers, masters, overlookers, and privileged licensed workmen only.

"No wholesale or retail dealer, if not a manufacturer, or if under thirty years of age, or who has failed in business, can be a member.

"The number of members varies with the size of the town; and are elected from the manufacturers in proportion to the amount of the trade; and from the masters, overlookers and licensed workmen. The latter electing one fewer than the former. Each member to be elected by a simple majority of votes present.

"The election to be by convocation of each class, held eight days after public notice, called and presided over by the prefect. Each voter shews his patent of privilege, and inscribes his name. Persons who have failed; those who have not exercised the trade for six years; who cannot read and write; or who have not returned materials given to them to make up, are excluded. The prefect decides upon any contested vote.

"One manufacturer, or one from all the other classes, shall be chosen to fill up a vacancy from death, retirement, &c., during the year.

"The members take an oath before the prefect or mayor, to fulfil their duties with zeal and integrity.

"The president to be elected by a simple majority who shall take their votes, express their will, and sign all documents.

"And a vice-president to act in his absence; both of whom shall be from the class of manufacturers. The judgments of the council to be executed by an officer to be appointed by the magistrates for that purpose.

"If the council be composed of 5 to 7 members, one member shall go out each year for two years; if of 9, two shall go out; if 10 to 15, three of each; but the third and each succeeding year those go out who were first elected; all are eligible for re-election. Expenses to

be verified by the mayor. These include pens, ink, paper, salary of secretary, carriage, postage, and expence in visiting workshops, &c.

"Every workman labouring in his own dwelling is amenable to the council before which his employer may be citable.

"In 1811 there were 156 trades named as under the authority of these councils.

"Their first duty is to reconcile; the second to arbitrate. Whatever the nature of the dispute if connected with manufacturing operations, and whatever the sum at issue, they are subjected to their decision. If of above £4 amount their decision is liable to appeal to the higher court. Their cognizance extends to the application of general laws, and new or revived regulations affecting masters or workpeople throughout the manufactories of the empire, particularly as to deficiencies in lengths, widths, quantities, size, weight, preparation, quality, or solidity of any work performed, or goods made of any materials whatever, animal, vegetable or mineral, prepared in shops, factories, forges, or laboratories. The councils decide upon all defects in work done in any trade whatever. They hear all complaints of want of solidity or quality in bleaching, dyeing, or printing, arising out of not using necessary ingredients for producing good colour or fine impression; or from injuries arising from employing corrosive or other destructive matters.

"All questions of responsibility of clerks, under-masters, overlookers, &c. as to making goods, buying, distributing, and using materials to workpeople; preparing and making up goods; their expedition to market; payments to workpeople; keeping of accounts; disputes as to wages, salaries, &c., between manufacturers, masters, under-masters, over-lookers, and clerks, come under their cognizance. Also, all questions as to bad materials, defective work, delay or refusal to work, or deliver up work finished, advances of materials or on wages; and as to all engagements entered into between employers and employed.

"These courts estimate all work begun, abandoned, or finished, whether disputed by masters, or men, and whether there may or may not have been an agreement as to the price to be paid for the labour to be put into them.

"And also as to work destroyed or injured while in the hands of workpeople, whether by accident, violence, or any other cause, where no fault is attributable to the workman.

"Also, as to the quantity and quality of raw materials, looms, harness fittings, tools, or instruments delivered to workmen, whether used at home or in the employers' factory. And as to refusal by masters to pay wages or to receive work from the workmen, whether by masters, clerks, or agents.

"As to the fulfilment or otherwise of indentures of apprenticeship.

"And finally, as to all damages and loss resulting from disobeying the laws or contravening the trade regulations, or not executing agreements amongst the above named parties; or from inferiority, defects, delays, or loss of goods, on the part of any of these classes from the neglect or misconduct of another. Upon insubordination or disobedience, on the part of workmen or apprentices towards masters, in their business, punishable under the old law by fine of 10*s*. or less, or 5 days imprisonment or less; the council may

inflict three days' imprisonment or less. If more serious they may send the offender to the ordinary criminal court, in custody if necessary.

"The court may not interfere with any matter of ordinary general police, affecting workpeople in factories, this being the duty of the mayor exclusively.

"The judgment of the council is without appeal as to imprisonment, and shall be executed by the ordinary police.

"These councils cannot take cognizance of the following matters with a view to deciding upon them; but they may do so in order to stating the facts, and preserving the things from abstraction, destruction, or alteration, necessary for evidence upon them before the superior courts, viz:

"Any combination of masters tending unjustly to lower wages; upon which crime the law inflicts imprisonment of from six days to a month and a fine of from £8 to £120.

"Any combination to hold stocks of goods with the intent of not selling below a fixed price; or any fraudulent practices, intended to raise or lower prices above or below the rates fixed by natural and free competition of commerce; against which there is the legal penalty of from one month to a year's imprisonment and a fine of from £20 to £400.

"Any fraud or deceit in the title under which merchandise may be sold, whether false weight, measure, or quantity; against which there is a penalty of three months to a year's imprisonment and a fine not exceeding a quarter of the sum restored nor less than £2.

"Any combination of workpeople to stop work altogether, or hinder it from going on, or for continuing it certain hours, or to raise its price; which subjects the offender to imprisonment for a month to a year.

"Any outrage, violence, menaces, or injuries by masters or workmen towards each other; for which the law inflicts imprisonment proportioned to the offence.

"The communication by masters, workmen, over-lookers, clerks, or apprentices, of any secrets in the manufacture in which they may be employed to any foreigner or Frenchman residing abroad, against which the penalty is solitary confinement and a fine of from £200 to £800, or to any Frenchman living in France, for which there is the legal penalty of three months to two years' imprisonment and a fine of 10*s*. to £8.

"The pillaging or injuring goods in shops, factories, &c., by combinations or riotous workpeople; the penalty for which is hard labour and a fine of from £8 to £200.

"Voluntary injury to materials or merchandize; or their abstraction from factory, or workshop, by persons employed; the first incurring imprisonment from two to five years and a fine not exceeding a quarter of the damage nor less than 10*s*. the second two months to two years and a fine not exceeding a fourth of the value, nor less than £20.

"And finally, thefts in workshops, factories, forges, and laboratories, &c., by those employed; involving the penalty of solitary confinement.

"Two of the council, one a manufacturer, the other a workman, shall be sent when necessary to search the premises of manufacturers

or workpeople; and on emergency, take such measures as may by securing things necessary for evidence, assist the course of justice and the conviction of offenders in all manufacturing cases.

"The council shall appoint a private committee composed of two members, one a master manufacturer, the other a master workman, over-looker or privileged workman. These shall hold a sitting every other day, where the council is of 5 to 7, and every day where it is of 9 to 15 members, from 11 till 1 o'clock. Their function is to reconcile applicants. If unsuccessful, they shall send them to the general sitting held at least once a week, and composed of at least two-thirds of the council. There, cognizance of the cases not reconciled shall be taken, and if not involving more than £4, their decison shall be final. If beyond, it may be carried by appeal to the chamber of commerce. These decisions shall be by the votes of a simple majority of the members present.

"The councils are charged with the duty of visiting once or twice a-year workshops and factories to inspect them, and take an exact account of all the machines and people at work in them. To obtain information useful in manufactures and commerce; to register it, and send it through the chambers of commerce to the government.

"No lawyers are permitted to plead in these courts, and the expenses are limited to a few shillings in any case."

The general establishment of trade boards of arbitration has frequently been requested by bodies of workmen at the hands of the legislature, and successive committees of the House of Commons have taken much and varied evidence on the subject. It presents confessedly great difficulties, but the necessity for a satisfactory solution of them is of equally great, nay paramount importance. Had the commission, at whose head has been placed one of the greatest of our revered judges, not been appointed, and through whose labours these questions will no doubt have great light thrown upon them, we should have ventured to express the view, which after long consideration, we take of them. But instead thereof, it will be of more practical utility to give an opportunity for contrasting with the French system, the particulars of a mode of conciliating differences between employers and employed, brought into operation a few years ago in the hosiery trade, the narration of the progress and present position of which we are about bringing to a close. The following public document has just been drawn up, and has been handed to us for this purpose.

"An account of the origin and progress of the Board of Arbitration and Conciliation of the Hosiery and Glove trades, of which Nottingham is the centre:—

"The hosiery trade for a period of two centuries has been spread over the counties of Nottingham, Derby, and Leicester. Leicester has long been the centre of the woollen branch, as Nottingham is of the cotton, silk, and merino branches, which form by far the largest portion of the trade. These last employ, according to Mr. Felkin's estimate, from 20,000 to 25,000 workmen in hand-frames (not reckoning the frames worked by steam power) spread over the counties of Derby, Nottingham, and the northern part of Leicestershire. The wages of these hand frame-work-knitters are regulated by the board of arbitration and conciliation, and all questions arising from wages are referred to it for settlement.

"There are few trades in the united kingdom in which there has existed so much agitation and irritation as in this. For a century past strikes have been frequent and protracted, and in some instances have led to disastrous and even fatal consequences. Luddism was an out-growth of the opposition to improved machinery, which the frame-work-knitters believed tended to reduce wages, and was not suppressed until several of its unhappy leaders suffered the punishment of death. Throughout the present century down to the year 1860, strikes and lock-outs continued; and in times of brisk demand the trade was constantly subjected to loss and embarrassment consequent thereon. Trades unions have existed in every branch from about 1780 to the present day. The trade has always had to maintain a sharp competition with the foreigner, and especially against the cheap labour of Saxony. The system of employing middle-masters, which is a necessity of the trade, is liable to great abuse; and the cupidity of individual employers has at times given rise to great oppression; hence there has always been cause for irritation and disunion, and however unreasonable the demands of the workmen may occasionally have been, their grievances have been many, and often calculated to embitter their minds against employers and their agents. From these dissensions both the capitalist and the workmen have been frequent sufferers. Strikes have heretofore been usually resorted to by the workmen as their only means of redress. Frame breaking and burning in effigy were amongst their worst consequences in the first quarter of this century; and in modern times they have been embittered by gross personalities and inflammatory placards.

"It was after a struggle of many weeks in the wide branch in the autumn of 1860, that the board of arbitration and conciliation originated. This was the third or fourth strike in the same branch during that year. The workmen struck for an advance of wages which their employers believed it would be impolitic to grant. The manufacturers met together to consider what steps should be taken to terminate the strike, and as the branches which were at work contributed to the support of the branch which refused to work, a lock-out was proposed. Before resorting to such an extreme course, some manufacturers wished to try conciliatory measures, and it was resolved to invite the workmen to a conference. This invitation was cheerfully responded to, and a deputation of employers met the workmen in the committee room of the chamber of commerce; and after a protracted discussion extending over several days, all difficulties were adjusted upon the express condition that a board

of arbitration and conciliation should be formed to prevent such calamitous disputes in the future. The board was immediately constituted, and met for the first time on the 3rd December, 1860, at the committee room of the chamber of commerce, where it continues to hold its meetings. At the outset it consisted of nine manufacturers chosen by a public meeting of their own body, and nine operatives selected by their respective trades unions. Recently the number has been reduced to seven of each, but in all other respects the rules appended thereto continue to govern the board in its constitution and proceedings.

"Questions of wages, the manner in which certain classes of work should be performed, and the rate at which new classes should be paid, constantly employ the attention of the board: but in addition other matters have arisen which have an important bearing on the material and moral interests of the workmen. One of the first subjects which demanded its attention was the abominable practice of the 'truck' system. Some of the middle-masters, whilst paying the regulation prices to their workmen, continued to keep them in a state of subjection by supplying them in advance with various articles of consumption, such as groceries, flour, cheese, bacon, &c. This, although in contravention of law, is sometimes very difficult of suppression, as it is not always done in a direct manner, but through some relative keeping a shop or store in which the employer possesses a secret interest. The goods supplied in this way are invariably charged much above the market value, besides being of inferior quality; and this is tantamount to a large reduction of wages, besides depriving the workman of his independence. The board advertised in the public newspapers their determination to stop the system by prosecuting the offenders, and by removing the machinery from any middle-master having recourse to such practices. A prosecution was instituted in one instance, and these measures had the effect of entirely stopping this oppressive system; if it is at all practised at present, it is in such a secret and mitigated manner as not to be known by the board. Another evil which reduced the purchasing value of the workmen's earnings was the custom of paying them in the villages at late hours on Saturday night, or early on Sunday morning, when no markets were available. This was also advertised in the newspapers as contrary to the wishes of the board; and individual employers guilty of the practice were written to in terms of remonstrance, and the evil thereby greatly checked, although, perhaps, not entirely eradicated. Deductions from earnings in excess of the customary charges of the trade have been steadily discountenanced and suppressed.

"When the board was first founded it was generally considered a doubtful experiment. Several manufacturers were openly or covertly hostile to it. Some regarded it as Utopian and impracticable; others, as likely to pry into the secrets of their business, and some as derogatory to their position and independence. These objections, however, have been steadily disappearing, until at the present time there are only two or three who refuse to acknowledge its decisions: but these are as effectually governed by its regulations as its warmest supporters; and the resolutions of the board have been generally loyally responded to by both masters and workmen. The decisions

at the board have always been conducted in the most friendly spirit and orderly manner. There has never been the slightest contention as to who should fill the offices of president or vice-president. The workmen propose a manufacturer as president, and the manufacturers a workman as vice-president. Whenever any breach of economic laws has been suggested by workmen outside the board, the operative delegates have always been the first to denounce it. The voices of reason and humanity have invariably had due weight with the delegates of both sections. And although both masters and workmen are accustomed to express their opinion of each other's individual and collective acts without the slightest reserve, no manufacturer or workman has ever been known to suffer from the free and honest expression of his views. One of the most evident results of this interchange of thought and opinion is, that the workman becomes better acquainted with the laws which govern trade and commerce, and with the influence of foreign competition; and the master learns how to appreciate the difficulties of the workman and to sympathise more with his trials and struggles to maintain and improve his position. It is important to notice that the success of this system is more attributable to its preventive than its curative character. Nine-tenths of the matters arising in the trade that would, if allowed to go on, produce dissension and irritation, are never brought before the board, but are arranged by the interposition of the committee of enquiry, who by taking prompt action, and by exercising a spirit of justice and conciliation, succeed generally in arriving at a satisfactory result: if unable to do so, a reference is then made to the board.

"During the disastrous years of 1863-4 the trade suffered terribly from the American war; manufacturers sustaining great losses and workmen suffering severely from want of employment. For the greater part of that period the board did not meet, owing mainly to the fact that there was no occasion for its services; but the committee of enquiry continued its duties; and immediately revived meetings of the board were alike called for by manufacturers and workmen, and the prices of labour were raised to a level corresponding to the demand.

"The strikes of former periods not only entailed great sacrifice and suffering on the workmen while they lasted, but necessitated large contributions before and after to sustain them. The trades unions sometimes levied as much as 1*s.* or 1*s.* 6*d.* per week from the scanty earnings of the stocking-maker for many weeks in succession, and the clothing and furniture of scores of families disappeared during a long strike. At present the contribution to the trades unions during some years does not exceed that of a single week under the old system. And the manufacturers have ceased to regard them as their natural enemies.

"The facts which the board points to as the best proofs of its success are—that during the six years of its existence no strike or lock-out has taken place, no personal attacks have been made, and no inflammatory handbills circulated. Never in the history of the trade has there existed so much good feeling betwixt employers and employed as at the present moment. And during the past two years, wherein labour has been scarce and agitation on the question of wages prevalent throughout England, the manufacturers in this branch of

industry, have been able to accept contracts without apprehension, and execute them without delay.

"(*Signed*)

Manufacturers.	*Workmen.*
H. J. Mundella, *President.*	J. Saxton, *Vice-President.*
T. Hill (Messrs. J. & R. Morley).	H. Farrands.
R. W. Smith.	T. Wilson.
T. Ashwell.	W. Foster.
J. H. Lee.	— Straw.
T. Black (Messrs. Rogers & Co.).	G. Kendall.
H. T. Cox.	John Lamb, *Secretary.*"

(*January*, 1867.)

The rules of this arbitration committee are these—

"The board to consist of seven manufacturers and seven operatives, The latter are elected one each by the Sutton, rotary, drawer and shirt, circular, rib top and wide half hose, wrought, and glove branches. The manufacturers are elected at a public meeting of their own body. All the deputies serve for one year, and are eligible for re-election in January of each year. Each delegate is to be entrusted by his branch with full powers to vote, and the decision of a majority present at meetings (the chairman having a casting vote) is to be binding on each branch. An annually appointed committee of enquiry, consisting of four members and the president *ex officio*, shall inquire into cases referred to it by the secretaries. Such committee to use its influence towards the settlement of disputes. If not able to adjust the business referred to it, such business shall be remitted to the board for its decision. In no case is the committee to make any award. A president, vice-president, and two secretaries shall be appointed at the annual meeting, and are eligible for re-election. The board shall meet quarterly; but on a requisition signed by three members to the president, he shall within seven days convene a meeting by circular, stating the nature of the business to be transacted, provided such business has been first submitted to the committee of enquiry and not decided upon by them. All complaints for the decision of the board shall be clearly stated and in writing one week at least before the meeting of the board. All expences incurred to be borne equally by the operatives and employers. Notice of any proposed alterations or additions to the rules must be given in writing one month before a quarterly meeting, or a special meeting to be convened for the purpose."

The annual report of the board for 1866-7, states—

"That the past year has been on the whole a prosperous one, employment in nearly all the branches of the trade having been abundant. The board has met eight times during the year for general and special business. The committee of enquiry has also met on several occasions, and all matters in dispute which have been submitted to it, have been speedily arranged. Six years experience of the practical working of the system of arbitration in place of strikes and lock-outs, has thoroughly convinced the board, that in a free country where workmen and capitalists have a perfect right to enter

into combination, the simplest, most humane, and rational method, is arbitration and conciliation. The demand for hosiery has been for two years exceptionally large, and workmen unusually scarce: and, though the workmen have preserved their trade unions, having now a central authority to appeal to, composed equally of employers and employed, all irritative questions and disputes and inequalities in wages have been adjusted, and the masters could accept contracts without fear, and the workmen's rights have been strictly preserved. At no former period in the trade has there been a more cordial understanding between them. This they trust may long continue, and so advance the interests of the trade and improve the condition of the workmen."

This committee of masters and men for arbitrating and settling disputes, is an arrangement which seems likely to be followed by one of equal or even greater importance, considering the extent of its proposed operations, and the very altered position of the work-people, from the demand for their labour and consequent advance in the prices it commands. 'Three county meetings,' as they have been termed, have been frequently held in times of general difficulty and distress; but from the diversified position of the respective trades in cotton, woollen and silk goods, as to the extent of demand experienced at any one time for their respective classes of labour, united action has always been found a matter of difficulty amongst the hands. Improved circumstances, whether internal from the effect of better wages, or external from the example and influence of other trades, seem to be operating to bring the whole fifty or sixty thousand frame-work-knitters into a closer union. Meetings have been held of delegates for some years in the several districts, into which the trade naturally divides itself. Within the past few months, meetings of a more general kind have taken place. These have issued in a "delegate meeting of frame-work-knitters, representing the three counties of Nottingham, Derby, and Leicester." This was held in Nottingham, June 11, 1866, Mr. H. Farrands in the chair. Reporters were present. The resolutions agreed to, were to the following effect:—

"That we form a general amalgamated and consolidated union, to be called the United Frame-Work-Knitters Society, to protect our wages and to render assistance to all the members who subscribe to our funds and conform to our laws. That the legislative power shall

be invested in an annual conference of delegates from the several local unions of frame-work-knitters in this association. Special meetings may be called, if necessary. That the executive committee consist of a president, secretary, and treasurer, and one committee man from each branch of frame-work-knitters. *That we recognise the power and assistance of the present board of arbitration in all its decisions according to the rules laid down by that body for the guidance of manufacturers and workmen.* The president shall preside over all general and committee meetings. The duties of secretary and treasurer are defined. That in case the general secretary cannot, when all other means have failed, bring any dispute to an amicable settlement between the meetings of the board of arbitration, then he shall have the power of calling the central committee together. That each member pay one penny per month for general expences; that each branch manage its own funds locally; and that if one penny monthly be insufficient to meet all general expences, the committee have power to lay on an extra levy to meet the same. General expences defined to be—board members expences, printing for general society, central committees expences. That when the services of the general secretary are required in any locality, that locality shall send a deputation with him and pay the expences; and the local secretary shall give him an account of the time occupied therein."

Mr. Farrands was elected president, Mr. G. Kendall, secretary, at a salary to be fixed after consulting the 'body at large,' and representative delegates were chosen from the 'three-frame,' shirt and drawer, wrought hose, glove, rib, fancy hose, and half-hose branches. There were thirty-five delegates present, only one of whom was from Leicestershire. Whether it will subsist and operate as a real and efficient general frame-work-knitters union, is yet to be ascertained.

Many and important modifications and improvements have taken place since 1836, in hosiery machinery of all kinds. The number of frames making two or more stocking legs at once, which were without narrowing, but straight down to the feet, was so large, and the price of labour so low, that, joined to the difficulty and expence of constructing new, speedy, and safe frames to work by rotary power, it was not earlier than about 1845, that the latter were got into extensive operation. But far more difficult problems than this had yet to be solved; especially the important one of putting fashion into the work by automatic action, and that without stoppage of the machine.

This had been partly accomplished by a plan of Luke Barton, hosier, of Arnold, who patented it

in 1838, No. 7545. Perhaps this may be justly said to be the first wide rotary frame in which the stitches were shifted automatically, along with performing all the other operations of the frame. It included a novel construction of sinkers, and a peculiar adaptation of bars for carrying into effect the operation of narrowing by ticklers and other essential movements, which were effected in a very ingenious manner.

Ever since that time, extraordinary efforts have been put forth to attain, by the simplest methods of adaptation, a good and perfect self-acting substitute, suitable for factory labour and management, in place of the narrow-hand fashioning frame of Lee, for so many ages domestically employed. Nevertheless, in regard to nearly all of those hitherto constructed, Lee's principal instruments are retained and used in one form or another.

The house of Paget, of Loughborough, is one of very old standing in the hosiery manufacture. During three-quarters of a century, they have been the largest producers of fashioned Derby rib goods, having maintained the quality to a high degree.

Being always alive to the importance of securing new inventions, added to improvements in machinery that might be devised by themselves, they noiselessly, about the year 1844, alighted upon the circular machine, the 'tricoteur' of Brunel, constructed many on that principle, and worked them to great profit. An early modification of these circulars was introduced. An upright cylinder was used, around which needles were placed, which were moved by an upward ascent in succession, and the beards were subjected to a pressing movement, as the needles were replaced in position below. From the peculiar form and application of the sinkers in forming the loops, these were called 'platine machines.'

Messrs. Paget's circular machines have just passed by sale into other hands; they continue to produce work of excellent quality, and can only be superseded by machinery possessing the additional recommendation of increased speed.

In 1857, Mr. Arthur Paget took out a patent, No.

930, for improvements in hosiery machinery, whereby it was made self-acting, narrowing without loss of time, and which might be put to inanimate power. The following are some of the principal changes made in it:

"Using levers without joints, hinges or pins actuating the sinkers or their equivalents. Holding needles by their hooked or cramped ends, in a cut bar or comb. A presser bar working behind the sinkers, pressing and relieving the needles at proper times. Knocking over the work by wiping the loops over the needle heads by a bar. By a double grooved pulley arranged to draw across once during a part of each revolution, and in opposite directions during each alternate revolution. Producing a selvage in any part of the width of the frame by throwing out of action one or more sinkers for a time. Making combs or bars with cut brass or iron backs on which gauge depends, and casting divisions on the backs in soft metal, so that the gauge of the bar may not be affected by the casting of divisions.

In 1859, a patent, No. 830, by the same gentleman, was obtained, modifying the former in the following important particulars:

By using a sinker to each needle actuated directly by an 'incline' and supported on each side by a grooved bar, kept in position by a spring. Using a presser bar with gaits or grooves for the sinkers to slide through, the walls of such grooves pressing the needle beards. Producing a selvage on any needle in the frame by means of the arrangement of a thread layer working exactly to and stopped at the required needle. Knocking the work over the bar by pieces of steel plate and securing them in gaits or grooves in a bar of metal.

Again, Mr. A. Paget patented in 1860, No. 624, improvements on both the above plans—

In thread carriers acting by an incline made to descend and pass between the needles at the end of each course. By alternately knitting web, and narrowing and widening it, or making changes in the web by moving levers or cams endwise in the directions of their axes, and another set of levers to be employed in narrowing, widening, or changing the knitting processes. Doing this by self-acting motion, by hand or pulley without arresting revolving cams. By stopping the catch block. By changing or suspending the speed of the rotary motion.

These machines with due attention work with safety, speed, and accuracy; producing excellent work. One of the largest employers of hosiery machinery of every kind, also one of the cleverest mechanicians known in

the trade, after a recent examination of several, asserted "that in construction, working quietly and efficiently, and in the character of work produced, they were the *beau ideal* of what Lee's machine with the application of automatic power throughout all its various movements in making fashioned work ought to be."

A modification of that important instrument, the thread carrier, spoken of at p. 108, is here described; and from this time, in power frames, its use has been constant, though diversified and improved. It has increased the speed of the stocking-frame to a surprising extent. To it has been attributed the origin of the fly shuttle and other important inventions. Two workmen laid claim to the thread carrier; the one, Sadler, who died in Mansfield workhouse at the age of ninety; the other, John Roe, who died in the House of Correction in Nottingham.

In 1828-9, Messrs. Warners, of Loughborough, assisted, it was said, by Hood in perfecting the movements, brought out a power stocking-frame acting by thread carriers without hand with suitably adapted pressing and slur motions.

In 1830-1, Mr. Mather, of Nottingham and Paris, with Messrs. Wakefield, introduced a frame having two tiers of needles and an independent instrument acting upon each needle.

Messrs. Foote and Moore's rotary stocking-frame and thread layer was arranged so as to make fashioned hose by widening them. This was completed in 1834-5, by the assistance of Mr. Donnington, of Nottingham.

In 1836, Mr. Cope, of Radford, is said to have constructed an eyelet-hole stocking-frame, the movements on the needles governed by perforated paper instead of cards, but on the principle of the Jacquard.

Mr. Coltman, of Leicester, produced a rotary stocking-frame in 1837. The jacks in this were without tails; small springs working in catches at the head of the jacks, and there was a snail wheel to stop the thread carrier in narrowing.

In 1839, Mr. Henson, of London, constructed a warp rotary frame having an extra lapping movement.

The same year Messrs. Barton and Fisher devised

a frame having a receding needle bar and thread carriers worked by rotary movements.

In 1841, Mr. Lupton, of Radford, put together a tickler stocking-frame, the motions in which were governed by a Jacquard apparatus.

The Lisle thread for the glove manufacture was first used at Leicester in 1834. In 1845 its use had increased tenfold over 1835. Messrs. Biggs and Bedell's introduction in 1845 of patent elastic twist bands had greatly aided this result.

Mr. J. Thorburn patented in 1841, No. 9075, a stocking-machine, the principal feature in which was the placing a row of the ordinary needles on a moveable slide, and after the loops had been made and the presser applied, the loops were forced, the needles were drawn backwards, the loops forced over the needle heads, and then the needles were brought forwards again.

The plan appeared at the time to be the swiftest then known, and was spoken a good deal of, but has passed out of notice.

In 1842, Mr. Stubbins, of Nottingham, introduced inlaying india rubber thread into hosiery.

A stocking-frame working by the use of levers was constructed in 1843 by Mr. Bedford, of Hinckley. The process is not known.

A person named Goddard is said to have exhibited some years since in Angel row, Nottingham, a curious but complicated hosiery machine intended to produce straight down (not narrowed) stockings. This frame comprised three straight lines or tiers of needles, and worked by rotary power. It was unsuccessful.

In the *Society of Arts Transactions*, vol. xxix., p. 84, a stocking-frame is described upon which tartan plaid Scotch hose were woven by Mr. John Robinson, by making some additions to the common stocking-frame.

Mr. William Ward, hosier, of Leicester, and Mr. D. W. Groucock, a framesmith, took out a patent in 1844, No. 10,216, for looped, knitted, or netted comforters, neckties, &c. made in a tubular form. In 1855, Ward took out another, No. 2708, for improvements in weaving.

Mr. Charles Nickells brought out a machine in 1847

which proposed the following novelties for arrangements in the machinery:

Making a compound fabric of three or more webs combined together in the act of weaving by shooting the various webs with the same or separate wefts. Weaving tubular or circular fabrics by making them duplicate instead of single as heretofore. Making duplicate fabrics with separated selvages; the two, three, or more fabrics being combined longitudinally in the act of weaving.

This plan was patented in 1847, No. 11,729.

In 1848 he patented, No. 12,364, a fabric for gloves, dress, and furniture.

In 1851 he patented, in connection with Ball and Bagley, No. 13,880, an improvement in machine for making loop knotted elastic fabrics.

Fabrics knitted with a cut pile, one set of needles in circulars to remove the work from another set of needles. Improvements in warp fabrics by causing weft or traverse threads to be laid in on either side of inlaid longitudinal threads. Improvements in looms for making narrow fabrics. The like in looped terry, fleeced terry, or cut pile surfaces, by applying india rubber for water-proofing, gloves, &c. For covering longitudinal india rubber threads.

This specification is an instance of a practice too often adopted of grouping together in one patent, heterogeneous and it may be important claims, where they might never be looked for or expected.

Nickells and Thornton took out a patent in 1852, No. 247, for weaving.

And, in conjunction with Hobson, in 1854, No. 2124, for using wires in making piled fabrics.

Messrs. Thornton Brothers, of Nottingham, took out a patent, No. 72, in 1853, for making looped mitts and gloves. Another in 1855, No. 2267, for looped work. Also, in 1863, No. 1962, for a coarse knitting machine to make the fabric for children's hoods, gaiters, and shawls. The knitted stitches are varied in size and form, or make by the action of bars and wheels or Jacquard apparatus. The product is an almost perfect imitation of hand-knitted or netted articles. This method is not confined to Thornton's, but is used by Harris and Sons, of Leicester, who have become interested in the patent. It is highly spoken of as an excellent and useful invention.

We learn from the interesting article 'Brunel,' *Encyclopædia Britannica*, 8th edition, that—

"Sir Marc Isambert Brunel" (the patentee of the round hosiery frame, and for aught that is known to the contrary its inventor) "was born in 1769 of an ancient family at Hagueville in Normandy. He early shewed a strong predilection to the physical sciences and genius for mathematics. He entered into the French naval service and made several voyages to the West Indies. In his fifteenth year he constructed for his captain a sextant with which to make his observations. Being a royalist he emigrated during the Revolution to the United States of North America, where he became an architect and civil engineer, and supplied several new and ingenious machines, while prosecuting national works—such as cutting canals, and erecting an arsenal and cannon foundry at New York.

"In 1799 Brunel came to England, where by 1816 he had completed his beautiful and effective block cutting machinery, which after fifty years remains at work without any improvement. These machines have more than most others tended to the substitution of machinery generally for manual labour. For this invention he was rewarded by Government with £16,000, and was further employed to put up extensive saw-mills at Woolwich and Chatham. He had already invented the ingenious little machine for winding thread into cotton balls, which has been one means of increasing greatly the use of cotton yarn; and found time to invent an instrument to multiply copies of manuscripts, by the use of several pens at once—a simple portable copying machine. Also a contrivance for making small druggists' boxes, previously imported from Holland. He gave some effective attention to nail making machinery; and discovered means to give the appearance of efflorescence to tintoil, fitting it to ornamental use. He improved the cutting of veneers, by using circular saws of large diameter, to which is mainly due their extended application to articles of furniture of various kinds. A little before the conclusion of the war in 1815, he devised a method for making strong durable and cheap shoes by machinery, which were used by the army. Brunel was one of the first to take an interest in the use of steam for marine purposes, especially in towing vessels to sea, and introduced during several years various improvements in steam-engines. He especially devoted time, money, and mental effort, in the endeavour to use liquified gases as a source of motive power, but in this he was not successful.

"M. Brunel offered his plans for constructing roads under rivers to the Emperor Alexander in 1814, with a view to one under the Neva at St. Petersburg. These being applied to the Thames, under his superintendance, issued in the existing tunnel, which was opened in 1843. This great work exhibits so much professional skill and energy, combined with facility of invention and resources adequately to overcome apparently insurmountable difficulties, as to secure a high position for the successful engineer amongst his brethren. Crowned with scientific and national honours, both English and foreign, he lived to the advanced age of eighty, dying in 1849.

"Sir M. I. Brunel was unaffected and simple in his habits; was possessed of indomitable courage, perseverance, and industry; while

his benevolent disposition prompted him to the kindest acts, and to the forgiveness of injuries or slights offered to him."

The amusements in mechanism or any other science of such a man, are often fraught with deep meaning, and may lead to important consequences. Brunel's attention had been so far drawn, according to his own evidence given in the bobbin net trial in 1816, to the manufacture of hosiery and lace, as to have made him acquainted with the whole range of machinery employed in it from Lee to Heathcoat. This fact, no doubt, originated the *round* stocking-frame, which was so devised by him, as not to employ any one of Lee's instruments, except the hook or needle, and though embodying Lee's principle, it was altogether different in its form and use. This apparatus, small and compact enough to be screwed to a lady's work-table, is capable of making loops of stockings faster than the eye can follow it, and though too slight a thing to induce even its inventor to push it into notice, was destined to become one of the cheapest and most effective looms the world has ever seen.

M. Brunel invented this round frame, which was patented by him in 1816, No. 3993. He called it the "tricoteur," the frame-work-knitter. It is a circular machine, as contradistinguished from the straight frame invented by Lee. A seamless sack is produced by its operations. The needles are of the same bearded shape as in Lee's, and similar loops are made on them by instruments acting as sinkers. These loops, when the beards of the needles are pressed into their grooves, are passed over the needle heads consecutively as fast as they are individually formed, and at once form part of the web already made.

The needles are firmly fixed on the external rim of a wheel or frame suspended from and fixed to a rotating spindle. They are placed in concentric direction, and at distances according to the desired quality and quantity of work to be produced. Another wheel moves on the spindle, carrying arms and knitting machinery, besides the bobbins of yarn to feed the machine. This thread as it is delivered is pressed down between the needles by 'pallets,' and is carried under the hooks. By an oblique movement the thread is pushed to the extremity of the needles by the first arm. The second arm carries a small wheel with long teeth like radii. The solid part of this wheel presses the needle beards into their grooves, and taking the web

already formed, slides each stitch over the beards of the needles, upon which the third arm carrying a wheel, throws the stitches over the needle heads. A fourth arm carrying a wheel like the second, places the stitches clear of the needle beards or hooks. Several sets of these wheels may be fixed round the spindle-wheel.

The diameter of the wheel or machine round which the needles are placed and work, may be equal to knit a circular web of any size, even that of a carpet. They are in fact worked of diameters, varying from two to one hundred inches. The work is continuous, only interrupted by the breaking of a needle or the thread, and therefore expeditious. The first row of stitches is made like that in the ordinary stocking-frame. As bearing upon the interesting question, by whom this ingenious machine was invented, Mr. Ferguson, in describing the introduction into France of the "point net" frame, has the following paragraph:—

"In 1801 George Armitage took the point net frame to Antwerp and constructed many more there. He then came to Paris; but finding that Hayne by his contraband proceedings prevented profit being obtained in making this lace, he effected many alterations there in the stocking-frame; and at length invented the circular hose frame, either there or in Prussia, to which country he took the lace frames. He brought the circular stocking-frames which he had made and worked in Prussia, to Cambray. I saw him working in one myself, and it was a very ingenious machine. Certainly he was one of the first men who made a circular stocking-frame."

Mr. Ferguson, from his personal knowledge, goes on to describe Armitage as "a singular and irritable old man; lame in body, but possessed of a lucid mind. About the year 1850, and at the age of 82, he announced his intention to make a voyage to Australia;" going, as he said, "to make himself acquainted with the country." This voyage he made, and died there in 1857.

Lace machines were sent or taken to Moscow by the same G. Armitage, who seems to have had a thorough knowledge of the modifications made in the stocking-loom up to the beginning of this century, as is attested by several competent persons, independently of each other. He might therefore have invented as well as constructed the round frame. But proof that he actually did so, is not forthcoming; and from the last sentence in Mr. Ferguson's statement, it may be

gathered, that *he* was not quite sure of Armitage being the real originator of this ingenious machine.

A circular or round frame, constructed like Brunel's, was placed and worked in the exhibition of art and machinery at Nottingham in 1840. It obtained, however, but little notice, the judgment passed upon it being unfavourable. There was an almost intuitive dislike to the idea of making stockings in the form of bags, both on the part of hosiers and frame-work-knitters. The former thought the character of the articles throughout the whole trade would be depreciated by the more general introduction of cut-up and stitched work; the latter believed it would inevitably reduce their wages, and prove the last addition to that cup of bitterness, of which for nearly forty years they had been compelled to drink. How mistaken both were will be afterwards seen.

In the year 1845, M. Peter Claussen, of Brussels, took out an English patent, No. 10,724, for an improvement on circular machines making looped fabrics. This was essentially Brunel's frame with certain altered combinations of parts.

He described a new kind of feeding wheels; employed pressure wheels varied in circumference so as to produce different patterns; applied comb pieces to this weaving of looped fabrics; and used steel needles.

One of these machines was placed in Nottingham for inspection by the hosiery trade; Claussen seeking their sale and use upon paying him a royalty. His agent offered to construct 26-gauge women's size at 15*s.* an inch. Amongst others the author carefully examined it, and was so convinced that this "grinding of hosiery webs" would not be said 'nay,' but must produce vast results, that after much difficulty he persuaded one of the most practical manufacturers of stockings in the trade to see it also. On leaving the loom, the latter fully acquiesced in opinion as to its immense power of production, but expressed the sorrow he felt in contemplating the evils it might, and most probably would, entail on the wrought and fashioned business forming the principal part of the manufacture. Many like him resolved not to use this new and most unwelcome class of machinery.

Claussen took out another patent, No. 11,658, in 1847, for further improvements—

By employing hooks to revolve with the needles; and attaching a winding up apparatus, not one of the least curious and useful appendages to this circular frame. For such is the rapidity and quantity of production, that to roll up the web as it is made, is absolutely necessary for many purposes.

The use of machinery constructed on Brunel's principle now increased, and that, before long, very rapidly. Some of the hosiers were required by Claussen to pay him tribute, he claiming originality of the principle, as well as of his modifications. This was resisted, and evidence got up for defence against an action; but he did not go to trial. To M. Claussen, however, is owing in good measure the practical resuscitation of Brunel's invention after it had slept so long, and the wonderful results of improvements upon it. There is little doubt that the first idea of thus simplifying and giving speed to the knitting-frame was conceived by foreigners, and to them belongs the great merit of introducing it here.

The next important change in circular machinery was produced by the advent of the 'wheel-frame,' so called from the operations of supplying the yarn, dividing the loops and of pressing them, and carrying them over the heads of the needles, being accomplished entirely by means of wheels. This mode of constructing and manipulating round machines is still more prevalent than any other for making plain circular stocking web. The cylinders are of every diameter.

In those round frames where the tumbler needles are used, the construction is such as to do away with wheels altogether, except that for driving the machine round.

Grooved cylinders are used in which the needles work and are raised up successively to the apex of a blunt cone and lowered again, carrying the threads from each feeder to each such cone. The raising the needles, feeding, looping, pressing, and passing the loops over the needle heads, are all performed by the operation of these cylinders upon the needles themselves. Mechanical art never devised a more simple yet effective plan for attaining very difficult results.

Another great advance made in the use of circular frames was in adapting them to the production of

Derby ribbed stockings, for which they are pre-eminently suited, because the lack of fashion in ribbed hose is of little consequence; the rib giving them tenacity to the surface, and an easy adjustment to the shape of the leg. The use of articles made from this frame has become very large; and in cotton and merino self colours from one or two feeders, they can be produced of such quality and of so respectable an appearance as to bring in sale very advantageous prices. This adaptation was the invention of Thomas Thompson, a frame-work-knitter of Nottingham, who, when visited at his own home on one occasion, was found busily engaged with the model, placed on a chair, of this circular ribbing frame, then in process of completion. We regret to be able to relate so little of the course of this clever inventor.

Mr. M. Townsend, who describes himself in his first patent as a frame-work-knitter, and afterwards as a hosier of Leicester, in 1847 took out a patent, No. 11,899 for the application of a 'machine like that of a point net frame to an ordinary stocking-frame.'

In this plan there are needles and hooks, of peculiar and ingenious shapes both in the loom, and on the machine attached to it. The mode of using them is too intricate to be understood without drawings. The invention is intended however, to take off the work by the machine from and return it to the frame instruments, in such manner that the direction of the loops may be reversed on the surface of the fabric, from time to time, as it is effected by hand knitting, and by workmen, on frames reversing them hitherto by hand.

In 1854, he took out No. 1,523 for making round hose, &c. with heels and toes fashioned on other machines. In 1856, in No. 1,157, he describes a method of raising looped pile on knotted fabrics for 'terry'—

Employing a row of needles or points, or their equivalents acting in combination by a Jacquard apparatus. Using a bell crank and lever guides similarly actuated, for throwing different colours into the work. Using 'hinge covering needles' in knitting double pile fabrics, and a notched sinker arranged as directed.

The same year, No. 1858, Townsend patented—

The application of jointed guides to the machinery of double barred knitted goods, so making figured patterns on both sides; throwing threads on one row of needles or hooks to form the pattern, and carrying surplus threads round the other row of needles to form

the pattern on the contrary side; the appearance of the pattern being made to look alike on both sides; sliding needles or hooks may be used, moved by the Jacquard in any direction. Using rows or circles of double ended needles having hooks or beards at both ends, and forming loops by a peculiar method. By placing double rows or circles of needles in an inclined position in lines crossing each other, each needle when depressed draws a thread to make a new course, without the use of loop wheels or sinkers. To make a broad rib it requires points to be used in combination. Making circular knitted warp fabrics, by using a row of 'tumbler' needles having '*hinged*' beards, circularly placed with lever guides to carry the threads forming the fabric.

The 'tumbler' needle was so called from the peculiar action of the small moving pin, devised and affixed just so far below the hook as that its point may reach the hook, or when reversed may lie in a groove. This invention of Townsend's is a very ingenious one, and has proved in the hands of others, a most useful and profitable one. The reader will form some idea of its shape and operation from the following explanation:—

The principal part of the instrument consists of a smooth thin iron stem, into which the lower end of a knitting hook has been soldered. The gauge of the circular frame in which these are to work, will determine the size of the hook, its length, thickness of its bed, and size and thickness of a bevelled square brass nog, fastened nearly at the bottom end of the stem into which the hook is fastened. This nog is put on that edge of the stem, toward which the hook at the other end is turned. The stem and hook are raised by the action of the rotating mechanism upon the nog; each consecutively falling into its place again by its own weight. While raised, the thread is taken along the stems of the hooks, and as fast as this is done, sinkers pass between them and form the loops. These being taken under the hooks, the previously formed ones will have to be got to pass over them and the hooks. With bearded needles this is done by the presser forcing the beards into their grooves, and allowing the former loops to slip over them and the needle heads. When hooks are used in hand knitting they are turned half round to allow the stitch to avoid the hook. Here comes in the curious device of Mr. Townsend. Immediately under the hook in the machine needle his stem is bellied out, a groove is made along it, in the centre of which a tongue half the length of the groove is *hinged* so as to work freely and which when raised to the point of the hook shall receive it into a spoon-like indent at the free end of the tongue. This will form in fact a smooth loop of steel, or when the loop of work rises from the stem, and seeks to pass the tongue now hanging with its point towards the stem, the work loop carries the tongue with it and at once reverses the position of the tongue, leaving it on the point of the hook, the work loop passes over both to the web, and the tongue falls into the lower half of the groove to repeat the operation in passing the next loop up and over the needle head.

Mr. Townsend was in the first rank of skilful manufacturers of fancy Leicester hosiery; and had a good practical knowledge of the machinery used in this trade. Having patented the needle, he seems not to have succeeded in getting it into very profitable or extensive use. Probably he fixed the royalty he required at too high a figure.

For various reasons he discontinued his business at Leicester, and took up his residence in the United States; where, after some of the vicissitudes to which inventive talent is peculiarly exposed, it is pleasant to hear that his undoubted skill has met with its reward.

These needles are now used in England to a very great extent; in France and Saxony also; and are exported largely to the United States, one house here paying nearly £1,000 a-year for this article to be sent thither.

Messrs. Hine, Mundella, and Thomas Thompson took a patent out in 1853, No 1967, for the improvements of the latter in looped fabrics made upon the *circular* ribbing machine.

In this the thread from the cop is carried under the *frame* needle beards by a looping wheel. As these needles are carried round, they are depressed by the lower part of the collar, thereby bringing their beards to the frame presser; and after pressing, the work is knocked over by the top of the collar. The work is then drawn back ready for the *machine* presser to operate upon it, at which point a plate draws the machine needles back, and the work is knocked over; the *frame* needles rise, and the *machine* needles are thrown out. The course is then repeated.

Messrs. Haddens patented in 1855, No. 2872, an improvement by Scattergood upon this patent machine of Thompson's.

A patent was taken out in 1854, No. 325, by Hine, Mundella, and Luke Barton of Hyson Green, for an application to the original stocking-frame of a *narrowing* apparatus; both frame and apparatus to be actuated by rotary motion. Hitherto only one or two hose of best (or fashioned) quality have been made in the widest parts on one machine; by this invention from two to ten hose can be made at once with less labour to the workman, at less cost, and with increased production.

Other articles, as shirts, drawers, half hose, &c. may be made.

The thread carrier is lifted up through the needles, and the jacks follow, passing over them; when arrived at the other side, the thread carrier descends through the needles, being stopped and secured up to the stop by a clutch cam. The frame is then sunk down and the loops are divided in the usual way. The loops are brought forwards, pressed over, the work is put back, and a treadle being depressed pushes in the ticklers and is held in the bolt in a catch-box. The action of the frame is then reversed; and a cam acting on a bar depresses the tickler points in the needle eyes, and the loops are brought on ticklers, which then rise and are shogged aside the space of so many needles as are required for the narrowing. The ticklers are depressed into the needles; the frame is brought forwards, descends, and carries back the work. The ticklers next rise off the needles, the pin in the cam drives back the bolt liberating the spindle bar, which is again brought into position by the spring. Thus the course is finished ready for repetition.

The same year, 1854, Hine, Mundella, and William Onion took out a patent, No. 365, for another rotary hosiery frame—

In which instead of using a fixed frame and machine needles, a moveable frame and machine needles are employed, working in fixed combs. The sinkers are also moveable, and work in the same combs by curved plates. A small sliding presser and thread guides are used. The machine is a rotary one. In the old rotary frames the threads are laid on the needles, the jacks are drawn, and the sinking, locking, pressing, and knocking over cams form the remainder of the course. All these movements are made in the present machine by means of curved plates; the course being completed in the same time as the jacks are drawn in on the old frame, thus producing two courses in the same time as one from the old frame.

The same house took out a further patent, No. 1448, in 1857, for improvements in looped machinery employed in making ribbed fabrics, with faces alike on both sides, exhibiting simplicity in combination and adaptation, resulting in superiority of the articles produced.

There are employed two sets of needles, each affixed to a moveable needle bar, with a stationary presser bar—but these are not new. The machine part which carries the sinker bar, hand bar, and spring bar, is stationary in place of having motion given to it; the knocking over bar being affected by the motions given to the needle bars. The parts are operated upon by a rotary motion. When lead sinkers are used as well as jack sinkers, the lead sinker bar will have a rising and falling motion given to it, to cause those sinkers as well as the jack sinkers to form the loops.

By this adaptation of parts facility is given for both sets of needles to pull uniformly at the machine course upon their respective loops, by which more perfect work will be obtained.

Another patent was obtained by the same parties in 1861, No. 2899, for further improvements in the stocking-frame. By this plan of constructing it, nearly every part, as needles, jacks, sinkers, and trucks are altered either in shape, position, action, or result, according as plain and ribbed work may be desired. The entire specification explained by the drawings must be carefully studied to give even a competent frame-work-knitter any adequate idea of the construction, working, and importance of the machine here patented.

One of the first attempts at arranging a stocking-frame so as to be capable of widening or narrowing at pleasure by the application of a Jacquard apparatus, issued in an invention devised by Mr. F. W. Mowbray, of Leicester, after seeing the Jacquard applied to the warp machine. This principle and method was made the subject of a patent by Messrs. Harris and Sons of that place in 1855, No. 327. It has been used extensively and with success not only by the patentees, but also generally by the manufacturers of goods produced on the lower gauges, which are mostly employed in the woollen hosiery trade, and to which the improvement is better adapted than to the finer gauges.

Mr. Edwin Stanley Brookes constructed a rotary Derby ribbing machine at Loughborough and patented it in 1857, No. 659. This proved an excellent plan, and was worked very successfully. Brookes emigrated to New Zealand, and the right to its use has been acquired by Mr. Shipley, in whose hands it is stated to be working to considerable profit.

Another rotary Derby ribbing frame was built by Mr. Bailey for Messrs. Mitchell, of Leicester. It was constructed so as to combine more plans than one, but in what way, not being able to obtain a specification, we cannot tell.

Mr. William Coltman, of Leicester, also built a wide rotary, but it was not capable of putting in any fashion.

In 1857, Monsieur Luce-Viellard, of Dijon, France, took out two patents in England, Nos. 1887 and 2884, for improved methods of making articles suitable for petticoats, curtains, and gimps upon the hosiery frame.

William Cotton, of Loughborough, took out a patent in 1851, No. 1660, for the manufacture of hosiery, widening the fabric by the action of the machine working upon rotary power.

In 1860 he took out another patent, No. 70, for a similar machine with the additional arrangement of its parts, so as to narrow as well as widen by the rotary action of the machine.

In 1863 he obtained a third patent, No. 1901, for a machine on the same principle of action with the former two in widening and narrowing the fabric by self-acting rotary apparatus, but on a horizontal instead of, as in the others, the perpendicular plan.

The needles in this machine are of the ordinary shape, are placed perpendicularly, the beards and heads uppermost. The presser bar is stationary, and acts by the pressure of the needles upon its edge, they being placed in front of it. The jacks are placed behind the needles and in an upright position on a jack wire, and have a round head working backwards and forwards, acting upon the jack sinkers, with which they are not connected by pushing them forwards; they themselves being forced up by a slur cock, and follow the thread forming the loops in the usual way. The lead sinkers divide the loops with the jack sinkers by the operation of a locking bar; the needles fall lower, and passing the divided loops the beards are pressed in the act of being carried down, and the loops are carried over the needle heads by means of fixed instruments devised for the purpose. A new and perfect course is thus formed and added to the former work. The jacks, sinkers, and other movements of the interior parts of this machine are affected and controlled by cams, locker bars, slaie, &c.

The widening and narrowing are brought about by the action of ticklers having one or more points in each, and which are placed on a moveable rod so ingeniously and accurately adjusted as to obey a side movement either way, to the extent of the distance of one needle only, whatever may be the gauge; and to take off, remove, and put on to the next needles any number of stitches required. The narrowed selvage is perfect; the widened one sufficiently so.

The essential knitting parts of the machine are compactly placed so as to work together safely and smoothly in the compass of six inches square, in the interior length of the machine, which is eight feet long and four feet in width and height. There is no

perceptible vibration, though it is not fastened in any way whatever.

The work on the 21-gauge frame under inspection, was making 26 courses when widening and narrowing, and 30 courses when making straight selvages per minute, which might be considerably increased with safety. The work is sound without tuck stitches or lines, and the machine is described as not breaking many needles. It is evidently a first class piece of mechanism both in conception and execution. The right to the use of this machine is now vested in the Nottingham Hosiery Company (limited), and Messrs. J. and R. Morley. The *Times*, in describing the establishment of Messrs. Hine, Mundella, and Co., in 1857, "as a model one for making hosiery goods from first class hand and power machinery," states "the number of hands employed by it in making goods to be 4000." The firm has been changed into a (limited) Company, and having absorbed the old established business of J. J. and J. Wilson, has greatly extended its operation. The Messrs. Morley employ in all about 5,000 frames. Other houses at Nottingham, Leicester, Loughborough, and Belper are very large employers of labour.

Samuel Hancock, of Nottingham, patented an improvement in machinery for looped fabrics. This was in 1854, No. 2166. It consisted of a great variety of substitutionary instruments.

In lieu of the old jacks and sinkers and presser, these newly devised means brought the work forwards on the needles; pressed down the beards of the needles; regulated the loops; knocked the work over the needle heads, and drew it back again.

Another arrangement dispensed with ticklers, by using instruments and methods for either narrowing or figuring the web whilst it was being made, so losing no time. It also included a method for working thread carriers on the working bars in widening or narrowing, and of using inclined planes.

In this machine the parts essential to forming the looped web, are comprised and worked in the space of three inches square, leaving room for parts required for narrowing, widening, and figuring. It cost in the construction much time and money; and though not brought into general use, it was at the time it was devised a considerable step in advance, and creditable to the mechanical talent of the inventor.

In 1858, Mr. Wm. Clark Gist, a citizen of the United States, took out an English patent, No. 1826, for a circular machine to be supplied by any number of feeders up to eight, where only one had been worked before. By this means striped work including sixteen colors may be made at once, and produce on a head of 4 inches diameter, or 12 inches round, 350 courses a minute. These courses formed by such a number of threads following each other, will be slightly spiral lengthwise of the web, but even in colors this is scarcely perceptible and not injurious in sale. Each such head would produce a yard in a minute, equal to a web long enough to be formed into 150 dozens of women's hose in a week. Several of these heads are managed by one person, usually a female.

Messrs. Hine, Mundella, and Co. purchased this English patent right. Immediately on its being worked in this country, a modification was introduced, by which Gist's valuable invention was simplified and the cost of the product lessened.

Thomas Thompson, who, as against Pepper, an American inventor, and Appleton, an Englishman, claims the honour of being the first to adapt the circular frame to produce Derby rib work, being at that time in Hibbs Brothers' employ, upon examination of Gist's machine, saw at once the way to improve it, by laying aside the ordinary stocking-needle, and using in lieu of it the *tumbler*-needle, invented by Townsend. This he accomplished; and the improvement was so great as to have been adopted extensively by firms at Leicester, for making striped goods; one house there having produced 5000 dozens weekly, on this plan. This modification was not patented, the tumbler-needle patent having then three more years to run.

After Townsend had patented his needle, other attempts were made to improve the shape and quality of this instrument.

In 1860, Mr. Greenough, of New York, took out an English patent, No. 1411, for barbed and other needles for knitting or sewing, by cutting, grinding, polishing, flattening, and bending, without removing or handling them until finished.

And in the same year, M. Quinquarlet, of Paris, took out a patent here, No. 1542, for an improvement in needles used in stocking fabrication, circular or otherwise, by which

To make them of tempered steel and of such length as to give them spring to dispense with oscillating movements of two needle bars in ribbed stocking-frames. From their fixed positions in circular frames to do without gearing for working the rib needle bar, and by these spring needles to render the construction of an interior ribbed stocking-frame practicable. Finally, there is economy in construction of the frames which are light and easy to work, these needles acting with simple and regular movements.

Mr. J. S. Wells, of Nottingham, devised and patented a needle in 1861, No. 1787, which had—

A short beard or hook in the groove; under the beard a slot is used, passing quite through the substance of the needle. In this slot is inserted a small piece of metal having a groove in its upper surface, which receives the end of the beard or hook. The metal piece passes through the slot and is rivetted to the bottom side of it so as not to be displaced. The piece is capable of sliding from one end of the slot to the other end, and the grooved portion is inclined downwards both ways.

The patentee also proposes needles, each end of which should have such beard or hook, and slot with a sliding piece, as above described.

In 1863, Mr. J. S. Wells took out a patent, No. 585, for a mode of strengthening the selvages of looped hosiery fabrics by using an additional thread carrier, so as to lay in an additional thread or threads on the needle or needles, on which the selvage is formed, whether in the leg or feet selvages of hose, and on the selvages or any other parts of other articles, where the addition of one or more threads may improve the seam and render it more secure.

A small domestic knitting-frame was contributed by a mechanician, named Bakenheim, to the Cologne exhibition a few years ago. It was highly spoken of. It had eighty-four needles, and the machine was said to weigh not more than 14 or 15 lbs., and might be adapted to any table for ladies' work. It is said to produce from 10,000 to 35,000 loops per hour, and to be worked with great facility. Whether it is a mere modification of the old stocking-frame, or of the circular

knitting-machine, or an entirely new arrangement, was not stated.

There need not be much surprise excited that frame-smiths have so often been eminent inventors themselves; for who so likely to understand the principles of construction of the classes of machinery to which they have devoted their lives, or to find out defects and remedy them, and throw aside round-about ways for obtaining desired results by eliminating the superfluous, and simplifying the intricate? From the higher rewards offered by the rapid and profitable development of the lace trade, the course of mechanical improvement was more marked for a time in that than in the parent hosiery machinery. But both were destined to witness similar triumphs of genius. The remarks made by one of the oldest of these practical mechanics, Mr. Attenborough, in regard to the construction of hosiery frames (wherein the firm of which he is the elder partner has attained a leading position) have long been felt to hold good by the best makers of both hosiery and lace machinery: "Their experience has shewn for the last fifteen years that the course of invention demands that the tools required to make all those kinds of machinery, should be of the most scientific character. For instance, the machines for dividing the bars of longitudinal, and the rims of circular frames must be, to do the work justice, mathematically perfect in their operation. Therefore no expense is spared to attain steady, accurate, and rapid movement in these intricate constructions. To get perfect models, a staff of model makers for this work alone is often employed at the founders. As the tendency is to employ power machinery upon the working of later kinds of hosiery machinery in increasingly finer gauges, the accuracy of machines and workmen engaged in constructing machinery is rendered the more necessary." The three principals of this establishment were foremen of mechanics in the employment of a Manchester firm, and adventured to come and direct their practical knowledge to building hosiery frames in Nottingham; by which they now give constant and well remunerated labour to about seventy hands.

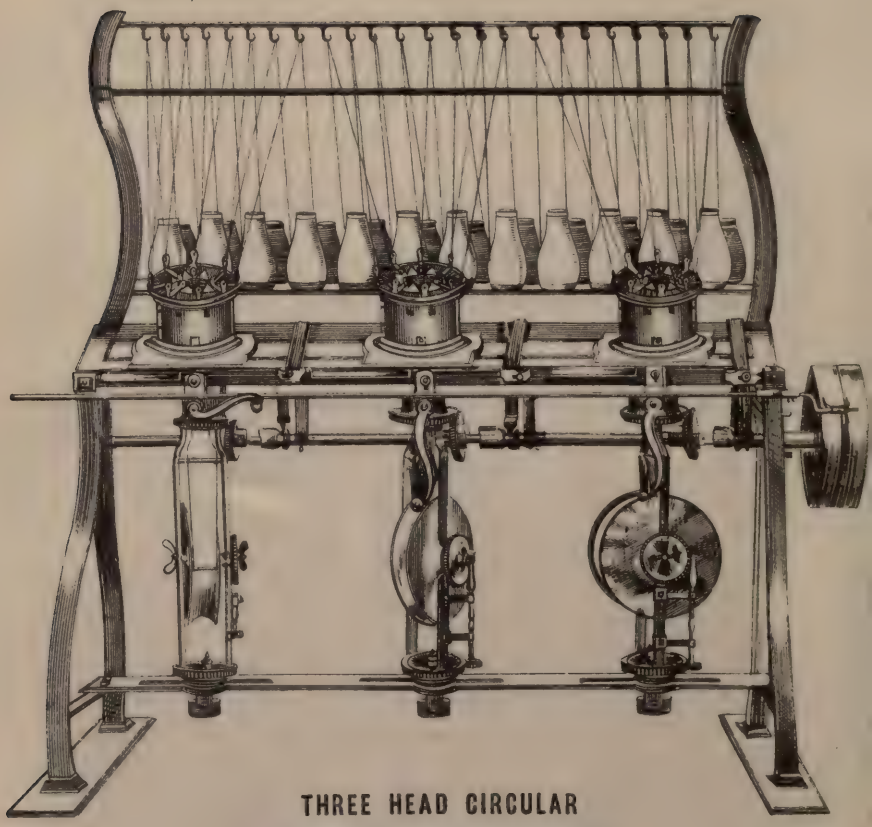
This house has lately constructed a rotary Derby rib machine, in which the operations for making ten or twelve webs of ribbed tops, six or seven inches wide, at once are performed by the self-acting adjustment of the mechanism, without loss of time or interference of the workman, either in forming the welt, the slack course to join on by putting in splicing to divide the tops, or striping to any extent desired—and this at the rate of thirty courses per minute. One machine will produce 300 dozens of medium sized ribbed tops in a week, and one man can work two machines. The quality of the work is excellent; and the cost is, of course, reduced in proportion to the saving of time, previously necessitated by the stoppages for the above named purposes.

In this machine the jacks are acted upon by a slur passing over not under them. They are steadied and kept in play by springs from behind on their tails. The jack and its sinker compose one instrument. The sinker is not moveable in the jack head as on a hinge, but is firmly united to it; and thus that portion of the wear from friction in this joint is got rid of. The shape and position of that part of this united instrument which answers to the jack is shorter, but still works horizontally; that part which acts as a sinker is rather altered in shape from the old one, and by its constant angle in work relatively to the jack part the division of the loops is effected accurately. The application of the set of upright ribbing needles to the horizontal tier of frame needles is so quick and perfect as almost to elude the observation of a bystander.

A variety of other deviations from the plain ribbed work, besides those above referred to, may be obtained without difficulty; inasmuch as the whole of the operations of the various parts of the machine are brought about by the action upon them of a wheel working at one end, the surface of which, being eccentric and uneven, can be so altered and its eccentricities arranged, as automatically to change or suspend and resume work, and thus vary the production in many important respects.

The following plain round hosiery machines, constructed by this house, may be described as reaching as high a point of production in quality and quantity as has hitherto been attained—

First. A tumbler needle round head, say of 26-gauge with *ten* feeders, producing a beautiful shaded web suitable when footed for



THREE HEAD CIRCULAR

TEN FEEDER STRIPING FRAME.

any use. This head, as the machine is termed, revolves once every second, being four inches in diameter, and produces 10 rounds or courses of loops in the second, equal to 30 inches in length of the round sack which is thus formed each minute. As there are 160 needles in the circumference, and by consequence as many loops, this head forms 96,000 loops in the minute. If worked ten hours a day, and five and a half days in the week, it will turn off 2,750 yards in length or 600 square yards of webbing weekly. One man was superintending two of these heads, turning off together 1200 square yards a week.

Second. A circular plain tumbler needle shirt machine, 18 inches diameter with 32 feeders, constructed on their own plan, making 26-gauge coloured stripes. This frame or head made 10 revolutions a minute; that is, it adds a band composed of 32 loops in breadth each revolution to the web in process of formation. As there are 928 needles in the circle and as many loops, this single frame makes 296,960 loops every minute. It requires 100 lbs. weight of yarn to feed it daily, or 12 tons a year. Its weekly production would cover 1000 to 1200 square yards. Machines of this capacity are being sent to all parts of the trade at home and abroad. One house employing them sends out a waggon load daily of their produce.

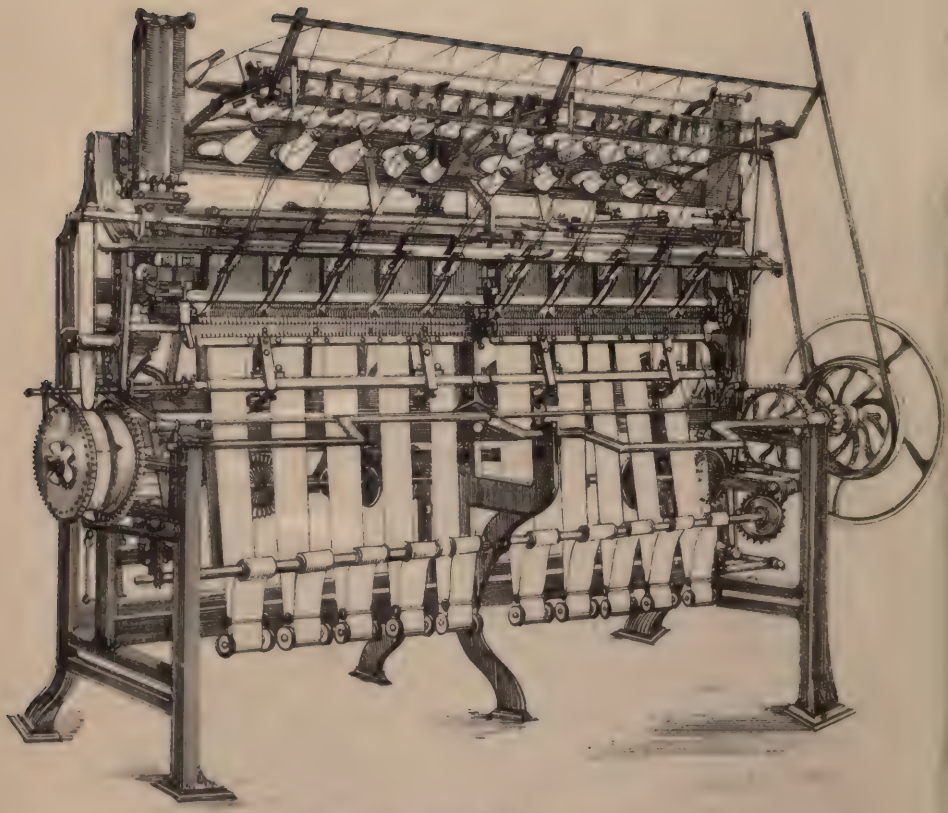
Third. In place of making very coarse heavy worsted hose on the lowest gauges of wide straight down frames, to be footed on other frames, and which required entire seaming afterwards, Attenborough and Co., have, by the use of a very coarse gauge tumbler needle on the circular frame, introduced a speedy and cheap imitation of the legs of Aberdeen knit goods, requiring only to be footed in the usual way. Being made round, half the seaming only is required. Almost any quality of yarn can be used. The demand for these machines is becoming very large.

Mr. Moses Mellor came from a village near Belper, to Nottingham, where after 21 years spent as an apprentice and journeyman in the business of frame-smith, he commenced it in 1844, on his own account, and has now 130 hands at work. He has confined himself to the construction of hosiery machinery, and latterly to the classes worked by steam power, upon improved mechanical arrangements.

In 1843, the machine devised and patented, No. 9883, by J. B. Wykes, of Leicester, in which there was a Levers' lace machine movement, and on which six hose could be made at once, was built by Mellor. On seeing Brunel's round stocking-frame which had been placed in the Nottingham Exhibition, Mellor improved it by placing the needles perpendicularly instead of radiating in a horizontal circle, and operated on them outside by an indented loop-wheel roller; and still further to secure the perfectly equal division of the loops, in 1849, he caused

another similar wheel to follow it. Both being bevilled, brought up the loops under the needle heads; a wheel acting as a presser, then placed the beards of the needles in the grooves, when an inside bevill wheel brings the work already made from the stems of the needles, and takes it over the beards, whence a fourth bevill wheel passes it over the needle heads, and an instrument follows to take down the web to the stems of the needles for a new course. The round frame thus arranged formed the loops more equally, independently, and safely, and consequently with increased speed, so as to thoroughly establish its use. In 1849, Mellor improved the wide power stocking-frame, which by the arrangement until then used for narrowing, raised the needles not at work out of the way of the thread; he introduced a thread layer, by which the yarn was placed between the needles where the selvage had to be formed, without disturbing them. About 1850, these wide frames received still further improvement by the formation of selvaged heels, through the operation of an additional thread carrier to each stocking, to be used while the two sides of the heel are in process of formation. It is only of late that this plan has come into more general use. These wide plain power frames we found were making 27 courses per minute in full width, and 20 while narrowing.

In 1863, William White took out a patent, No. 1236, for an ingenious series of modifications in the round stocking-frame, whereby plain, striped, and fashioned fabrics are produced. This was the invention of Moses Mellor. It was followed in the same year by a patent taken out in his own name, No. 2,778, for an invention to be applied to a reciprocating straight frame, making one or more breadths of work at once; or to a reciprocating circular frame, making one or more breadths at once; each machine producing a fashioned selvage, broad, ribbed, plain, or patterned looped fabric; or to be applied to a continuous circular frame. This is effected by the arrangement here patented, added to the use of the fashioning and striping apparatus in White's patent; and by altering alternately the position of the inclines after one or more courses, and working



ROTARY RIB TOP FRAME.

other way for one or more courses. A fabric results either plain or ribbed in one part, and having loose loops on the other part; the patterns varying according to the setting of the machine. This combination is described as a circular and selvaged three-press broad ribbed knitting-frame; and is considered to be constructed upon a plan highly creditable to the inventor, and calculated to prove very useful and profitable to the trade. Mr. Mellor has earned the character of a first class mechanician, and an unobtrusive, yet talented man.

In this year Mr. Mellor constructed his first wide or longitudinal fashioning Derby ribbed frame. This increased the production by one workman, ten or twelve-fold over the original Derby rib frames. This he threw open to the trade, and it was first used by Messrs. Corah, of Leicester, the cost being £120 per machine.

The circular patent frame costs £18 per head or £108 for six heads. A man superintending six heads, each two feeders would produce 100 to 120 dozens a-week of women's or men's hose. The ribbed wide rotary making twelve six-inch tops at once, will produce about 320 dozens a-week.

The beautiful and varied productions from ribbing machinery, whether circular or longitudinal, are such that at the present time more are made in a week than formerly in a year. The demand is still rapidly increasing, and likely to continue to do so.

Returning from this important series of mechanical modifications to the general course of the trade, when the proposed treaty of commerce between England and France was under consideration in 1860, the chamber of commerce in Nottingham drew up a statement, of which the following is the substance:

"English hosiery is chiefly made in the counties of Nottingham, Derby, and Leicester, of which the delegates represent all except the woollen hosiery manufactures of Leicester.

"The materials used are cotton, silk, spun silk, and a mixture of cotton and wool called merino. There are four classes of machinery, hand, rotary, circular and warp frames.

"There are about 5000 kinds of articles made upon them: stockings, shirts, pantaloons, caps, gloves, and mitts, in all sizes, and also piece goods for gloves, &c.

"The oldest branch is work made by hand; it is a domestic manufacture chiefly, and consists of two branches narrow and wide; the greater part are narrow frames, numbering 40,000 to 50,000. These are from 12 to 16 inches wide, and in the lower gauges require less skill and strength, therefore are worked chiefly by old men, women, and young persons of both sexes. The finer gauges require a good sight and more skill. The average earnings are lower than in the other branches, and run from 6*s*. to £1. 4*s*. a week.

"The wide frames are from 25 to 30 inches in width, and the earnings are from 16*s*. to £1. 10*s*. weekly.

"The rotaries average 40 inches wide, though some are of much greater width. These are worked in factories by steam power, regulated by the Act of Parliament, and worked 56 hours a week. The earnings are from £1 to £1. 10*s*. weekly. There are about 1,200 of these machines, and all are worked by men.

"The circulars are similarly placed in factories and employed like hours, but are attended by both men and women. The men earn £1 to £1. 15*s*., and the women 12*s*. to £1 weekly. There are estimated to be 1,500 sets of heads, employing at the frames from 2,000 to 2,500 hands.

"The warp machinery at work upon hosiery is not extensive; there are about 300 frames, averaging 90 inches wide, worked in factories by men and youths, earning from 16*s*. to £1. 15*s*. weekly. The manufacture of warp pieces to be cut up and made into gloves has been considerably developed of late years, and more so it is believed in England than in France, for French glove makers have desired to import these pieces, but have been prevented by a prohibitory tariff.

"The working of rotary, circular, and warp frames by steam power cannot be avoided. There is required therefore the cost of factories, engines, and other appliances absorbing large capitals; the interest on which, coupled with the expense of working, has to be added to the wages of workmen. The rates of wages are higher, and hours of labour are shorter than in France and Germany, necessitating economy of human labour. The owners of such costly machines must have strict control over the working hours, to secure an adequate amount of production; keeping them in proper condition requires supervision by skilled mechanics. It is thus evident that in steam factories there must be added to the wages of the frame-work-knitters the interest on building engines, gearing, &c.; cost of repairs; the wages of engineer, smiths, and overlookers; cost of coal and gas; depreciation by wear and tear; and loss by the introduction of improvements, which in some classes of machinery has been very great.

"The hosiery business employs a large number of auxiliaries in finishing goods for the market, as cutters, stitchers, menders, folders, &c., the women earning from 8*s*. to 16*s*., the men £1. 5*s*. to £1. 10*s*. weekly.

"The English home consumption far exceeds that by export. The duties for years past on hosiery imported into England have been only 6*d*. on hose and 3*d*. on half-hose and gloves per dozen.

"The manufacturers of France have free access to all English machinery, every class of which is increasingly in use in France.

Many articles of the largest consumption are made and finished there at a lower cost than in England; this is an advantage so great, that if the duties on these were entirely abolished, the English could not compete with them. Where the English cost is below that of France, it is believed to chiefly arise in the classes where there is the absence of modern machinery in the French hosiery manufacture.

"It is confidently hoped that the French tariff may be so arranged as to permit of an interchange of some branches of our manufactures, producing extended commerce and increased good will between the two nations.

"(*Signed*) A. J. MUNDELLA.
T. ASHWELL.

"P.S. The delegates find on comparison that where labour enters largely into the cost of production, the French manufacturer enjoys an advantage; but where machinery performs the most important part, English goods are cheapest. They suggest that if English goods were permitted introduction in the state they leave the loom, on very low duties, their lower priced labour in finishing would be to the advantage of France, and they would also obtain the advantages of English machinery.

"The number and variety of articles in hosiery precludes satisfactory classification; but judging from the experience of the United States, duties levied *ad valorem* would work sufficiently well for both revenue and commerce."

The French treaty has hitherto disappointed the expectations of the English makers of cotton hosiery, for which the demand has been but little increased. It had been supposed to be specially adapted for that market.

One of the most marked, not to say discouraging features in the present aspect of the English hosiery manufacture, is the decay and almost extinction of the silk branch of the business.

It was said that there were 7000 silk frames in the trade when waistcoats, small clothes, gloves, and stockings were worn made of silk hosiery. In 1812 it was computed there were 2156; in 1833, 3000. In 1835-6 the silk hands in Derbyshire obtained an agreed statement of prices; their wages averaged 18*s.* a week, and in this agreement it was specified that it should be a rule of the silk trade throughout Nottinghamshire and Derbyshire, that no repairs of frames except for needles and pewter, and no damages except by his fault, should be charged upon a workman; or any other charges made but for firing or ill made work; also that journeymen should be paid the whole price given by the hosier for extra labour. An allowance for waste according to weight of materials used was also agreed upon. But the number of machines in Derbyshire had fallen to 1,500 in 1840, of which it was ascertained that 790 were idle. The men at work earned 8*s.* on an average weekly. In 1844 there were 756 hose and 698 glove frames using silk in Derbyshire; 687 hose and 1407

gloves using silk in Nottinghamshire, and 223 elsewhere, together 3,773 silk frames. We have not been able to ascertain the number of silk frames at work making stockings and gloves during the past year in Nottinghamshire; it has not fallen quite so low as to be in proportion to the present number in Derbyshire, but the trade has been rapidly declining the last ten years. In Derby there are about 35 making hose, and 40 making elastic silk bandages for surgical purposes; and in the county 60 making hose; total 135; not a tenth of the number in 1844. There was only one apprentice in this branch at Derby. The hands averaged sixty years of age, and earned about 13*s.* a week. Their defective sight renders it somewhat difficult now to find workmen able to make the finest gauges necessary to furnish hose suitable for a royal *trousseau*. The wages earned on the elastic bandage frames run from £1 to £1. 10*s.* a week.

It is natural to ask for the causes of declension, and almost cessation of demand for silk goods. Change of fashion has no doubt much to do with it. People will not purchase silk hose to be worn under long petticoats, or trowsers, or boots. But it may be that inferior quality has also had an influence. Slight materials produce lower cost, but at a much greater expense in the wear of goods. And if, in order to lead a buyer to suppose he gets a heavy article, the silk is weighted with dye stuff, the cheat will be discovered at the first washing, and the article itself will fall into disuse.

In 1864 there were in Nottingham and the county, 69 wholesale hosiers, and 12 glove manufacturers; and of trades connected with them, 24 master framesmiths, 8 master sinker makers, 29 master needle makers, 12 bleachers, 39 dyers, 6 trimmers, and 55 hosiery agents, 10 cotton and silk spinning factories.

In Leicestershire 144 hosiers, and 23 glove manufacturers, 20 master needle and 13 master sinker makers, 45 master framesmiths and machinists, 19 elastic web-makers, 35 dyers and trimmers, 26 worsted and lambs wool spinning mills, 26 wool staplers, 7 waste dealers, 15 woollen and cotton yarn agents, and 7 fancy box-makers.

In Derbyshire 30 hosiers and 20 silk and cotton spinning mills.

In the hosiery business of Nottingham, there were at work in 1865, 11,000 narrow hand machines, employing domestically 7,500 men and 3,500 women and youths, at wages from 6*s.* to £1. 6*s.*, averaging, by the statements of the hands themselves, 10*s.* 6*d.* weekly; also 4,250 wide hand machines, likewise domestically employing 4,250 men, from 10*s.* to £1. 10*s.*, averaging, according to the workmen's statement, 15*s.* weekly wages. These 15,250 hand frames were placed in 4,620 shops, in eighty parishes spread over the county of Nottingham. The entire average wages of 42,000 frames at work throughout the whole of the hosiery trade in 1844 was about 6*s.* a-week only. These two classes of Nottinghamshire hand machines,

it is computed, give employment to about 20,000 women and girls as winders and seamers, earning 4*s.* each on an average. There are about 1,000 wide power rotary frames, employing 700 men, at from £1 to £1. 12*s.*; and about 1,600 girls and women, seamers and winders, on an average of 5*s.* weekly. There are about 1,200 sets of circular round power frames improved, employing 500 men and 500 youths, at from 12*s.* to £1. 5*s.* weekly; and 1,000 women, getting 12*s.* to £1. weekly wages. The winders, cutters, menders, and others attached to these are about 11,000 women and girls, averaging 7*s.* to 12*s.* a-week. And there are about 400 warp machines making hosiery by power, employing 400 men, at 14*s.* to £1. 15*s.*; and 200 youths, at 12*s.* to £1; besides 400 warpers, &c. (men), gaining about £1. 5*s.*; and also 2,000 women and girls, stitching, &c., at 8*s.* a-week on an average. It is probable that there are 2,000 men employed in bleaching, dyeing, &c., and as porters, &c., at £1. to £1. 15*s.* weekly; besides 5,000 menders, folders, &c., working in warehouses, at from 8*s.* to 12*s.* weekly. To these must be added the warehousemen and clerks in eighty establishments for finishing and sale of goods in Nottingham. The Nottingham hosiery business is now believed to be giving employment to about 17,000 males and 44,000 females—together 61,000 workpeople. The estimated returns amounted in 1865 to about £3,000,000.

The two staple trades of Nottingham, hosiery and lace, distributed in returns an amount of somewhat more than £8,000,000 sterling last year, and furnished, in the aggregate, employment to nearly 200,000 workpeople.

The returns of the entire English hosiery manufacture, in 1851, were computed to amount to about £3,600,000. In 1862 the returns were calculated to have risen to £6,480,000 of which materials were £2,630,000, and wages and profits £3,850,000. This great increase was chiefly due to the increase in power goods. The advance in the price of all the raw materials used averaging 50 per cent. raised the returns in 1865 to £7,795,000. Cotton wool has fallen very seriously since then, and animal wool is of lessened value; therefore the returns of 1866 have probably been in some measure reduced in amount. This is not however certain. For every effort was put forth in 1865-6, for the construction of new and reparation of old machinery throughout the English hosiery trade. The cessation of civil war in the United States of America, and consequent revived demands from thence, gave a fresh impulse to this business.

The number of hands employed in the entire English hosiery trade of 1866, is computed to be as follows; 42,000 working narrow frames, 8,000 at wide ones, and about 100,000 menders, seamers, winders, cutters, finishers and makers up, chiefly women and children, total 150,000. So that these two English trades of machine wrought hosiery and lace combined, gave employment to about 285,000 persons; and produced a return of £13,000,000 last year.

It is difficult to say, with any approach to accuracy, what proportion of the hosiery production of England is consumed at home, and what is exported. The Custom-house returns, whether as to export and imports

of hosiery and lace, are exceedingly defective; and steps ought to be taken to reform them, so that they may shew the approximative amounts. The quantity exported is very small. It is, however, certain that the exports of hosiery are increasing to India, Australia, Canada, and the Cape. It is doubtful whether English hosiery has not been, during the internal war in the United States, replaced by goods of their own manufacture; and also, whether the extraordinary tariff is not causing such an amount of home machinery to be employed by them, as may have the effect of permanently lessening the proportion of our supply to their consumption.

CHAPTER XXX.

SAXON HOSIERY MANUFACTURE.

Although Beckmann quotes the statement that the consort of the Duke of Pomerania, when at an advanced age, in 1417, she could no longer sew nor embroider, amused herself with knitting continually, yet he does not give it credence; and there are no authentic records of the time and circumstance or by whom the introduction of hand-knitting took place into Germany. It is first spoken of there in the middle of the sixteenth century. The art was known at Berlin in 1590. It is equally unknown when and by whom the first stocking-loom was taken to Germany. But it was chiefly spread through that empire by refugees from France, after the revocation of the Edict of Nantes. These carried to Hesse the first stocking-looms known there. French names were given to all parts of the machine; and by these names they are called at Pausa, in Saxony, at the present time; where iron frames are at work, which were constructed at, or at least brought from Hanau, near Frankfort, shortly after that time. The first stocking-frame which was seen in Vienna was taken thither by one Becker, who constructed others of wood. They are made of that material now, at Olbernhau, in the Erzebürge, a district surrounding Chemnitz. In Beckmann's time "these sold for 28 thalers (£4. 4*s.*); though," he goes on to say, "iron ones, of a most inferior kind, sell in Voigtland for 60 or 70 thalers (£9 to £10. 10*s.*)."

Eventually the stocking-hand-knitters and stocking-loom-weavers (of each of which there were many in Wurtemburg) were arranged in separate guilds. The members of one class of these societies were not permitted to wear the productions of the other. "Save that the

laborious poor men, women, and children, with those who watch" (their sheep and goats, or the sick), "and at the same time knit, may wear the work of their own hands."

These hand-knitters in Wurtemburg wrought a carpet three ells long, and two and a-half ells wide, when it was milled, in which were flowers and figures. This elaborate piece of workmanship was thought to have shewed the hand-knitting art brought to an astonishing point of perfection.

After the establishment of the French hosiery manufacture at Rouen, in Paris, and the city and district of Troyes, it is said that a silk hose frame was taken from France to Chemnitz; but it is probable that this machinery was taken southward to Nismes, and eastward through Frankfort and Hanau into Bavaria; then gradually proceeded northward to Ash, Brambach, and the whole surrounding district; thence on to Zeulenroda, where the manufacture of hose from iron frames has been carried on for about two hundred years; and thence to Chemnitz, seventy miles off. There, from the neighbouring Erz mountains where wood is plentiful, and a great deal used for making into toys, &c., the stocking-frame came to be made half of iron and half of wood in some of its important parts—as wooden jacks moved by a wooden drum with nicks cut in it. They were made at the relative low cost of £4 to £8 each. Some of them are now neatly ornamented with inlaid wood-work.

The growth of the stocking manufacture has been very rapid in Saxony, since the beginning of the present century, with frequently recurring periods of depression. Chemnitz, in 1840, contained about 20,000 inhabitants only, and the whole country was estimated to employ about 20,000 frames, making 2,500,000 dozens of hosiery goods, and exporting them to the amount of £750,000 a year. At that time employment was scarce and wages miserably low. A man could not earn more than 3*s*., and a woman 2*s*. a-week. In 1851, the Saxon report to the exhibition in London, stated the number of looms to be 30,000, employing 45,000 hands. The workpeople are frugal by necessity and

habit, and in most of the larger towns, seem to be fairly educated.

The following are facts derived from reports to the Saxon Government upon the latter interesting subject:—In Chemnitz, public school instruction is carried out systematically, under the authority and careful inspection of the Government or its municipal representatives. Every child from six to fourteen years of age must attend a school at least four hours a day. In this city where there are about 55,000 inhabitants, amongst other scholastic institutions there are four "peoples schools," in the two lower of which 4,580 boys and girls, and in the two higher 2,970 boys and girls are taught; the fees in the former being 7*s.* 3*d.* a year, in the latter £1. 10*s.* a year, each pupil. There are in these four schools 7,550 youths taught at a total expence of £8,513, for which fees are received amounting to £5,200, leaving £2,870, to be charged on the town funds, and £443 on other sources of income. They are under the management of a superintendent, four directors, and one hundred and six teachers. The buildings cost the municipality £30,387, interest on which raises the cost of each pupil from £1. 2*s.* 6*d.* to £1. 6*s.* 3*d.* per annum. The public grammar school with 378 scholars, and 346 more in the Polytechnic, (the fees in both which are about £4 a year), and other schools, including those where weaving and the construction and use of machinery are taught, afford supplementary education of a higher order preparatory to that of the Universities.

The municipal council of Chemnitz have paid £42,500 for school buildings and furniture. In 1865, the town funds were taxed to the extent of £3,000, and the state funds £4,000, for educational purposes in that city alone, beyond the large sum paid by the parents themselves. But so successful is the result, that it is in contemplation to erect district schools; and thus bring an excellent though compulsory education almost to the door of every dwelling, whether its occupants be rich or poor.

The Saxon hosiery manufacture has two principal centres, Chemnitz, and Stollberg, for the employment

of wooden frames. The account about to be given of these, chiefly from official sources, may be fitly introduced by the following particulars, extracted form *The Guide through Chemnitz*, by Julius Pinther, printed in 1865, under the head of 'Stocking Weaving.' The compiler says:

"This is a branch of industry founded in 1728 by three persons, Roeder, Braun, and Saur; who transplanted the manufacture of cotton hose, caps, and gloves to Chemnitz, in 1765 when stocking weaving by hand was constituted a guild. Already in 1802, this guild produced more than 50,000 dozens of hosiery." (This would require about 1000 frames,) "In 1820, it numbered 1538 master workmen, 630 journeymen, and 346 apprentices. There were two presidents or head masters, and 85 district masters for the villages in the neighbourhood."

The firm now trading under the names of Gottlieb, Hecker, and Soehne, has been established in Chemnitz, 103 years.

There are now in Chemnitz 45 hosiery firms, of whom 20 make hose, 11 gloves, and 14 both. There are 10 in Limbach, 3 in Hohenstein, 3 in Lichtenstein, 4 in other places, making a total of 65 firms in the 'wooden' frame district.

The surprising extension in the short period before mentioned of the Saxon stocking manufacture, is a subject of such deep interest to the English, French, and American trades, as to justify the insertion of that authentic information, in its entirety which has been collected upon it.

The following is part of the "report of the chamber of commerce and trade for the district of Chemnitz, Saxony, for 1863" presented to the Home Minister, relating to *stocking-making*. It was drawn up by Mr. Hahmann the President, a partner in the firm of Hecker and Coventil, 1865, when he retired. He is an exceedingly well informed and impartial man. (The italics are ours throughout.)

"The manufacture of handwoven stockings &c., in Saxony, which according to the last statistics, gave employment to about 45,000 hands, of whom there were about 30,000 males and 15,000 females, has reached its present importance within the last 40 years; although in the last half of the last century, the hand loom hosiery weaving in the Erz mountains, was a regular branch of industry. The merchants who traded at that time in woven fabrics, such as 'Pignees,' 'Canevas,' &c., took also the products of the stocking-frame, and

so brought them into the wholesale trade. They gave out to the stocking weaver the material; the raw cotton, principally 'Macedonian,' being spun by hand; and he had to make it up into stockings, caps, &c., according to the wants of the trade.

"Saxony soon won for itself a name in these articles, and increased its returns in Germany, and through the various fairs to Poland, Russia, Italy, and the Levant. But the political revolutions at the end of the last and commencement of the present centuries, together with the heavy and varying import duties of the different countries, hindered its uniform progress and development, and after longer or shorter favourable periods, caused times of very disadvantageous stagnation.

"Soon after 1820, several manufacturers turned their attention to the Trans-Atlantic export trade; which had become developed in Germany, but in which as yet, the Saxon hosiery trade had not taken any part. German importers from the United States, stimulated the manufacture of stockings in imitation of English samples, which led to decided improvements in style, fashion, seaming, bleaching and trimming; whilst the yarn now spun by machinery, enabled finer qualities to be made than hitherto. Thus an export business was founded; which though it has had its crises, has powerfully assisted in the growth of this branch of industry. Saxony has competed with success in all ultra-marine markets, where the cheaper though commoner Saxon goods are preferred to the English. The workmen earned their daily bread in abundance; and it was *still better for them, when between* 1830 *and* 1840, *the manufacture of 'cut' goods from wide frames began; and the article 'cotton woven gloves' first came into general use.* Unfortunately, the endeavour after improvement, did not go hand in hand with the improved condition of the work people. The better the earnings, the more careless were they in their work. They were deaf to every remonstrance to hold to good quality, or to make use of new and better methods. Every thing to which they were unaccustomed met with opposition, which was only subdued by necessity. This came in the form of a stagnation in trade, once in about every four or five years. For instance, wide hand frames *with carriers*, making several 'cleared,' *i.e.* fashioned hose at once, were in full employment in England in 1850-1; and through the division of labour, legs, heels, and feet, each made on separate frames, were produced at a cheaper rate; while with us, the same means have only been introduced on an extended scale for three or four years.

"The patent of J. G. Heynig, of Neustadt, near Chemnitz, which has simplified the making of heels and toes, and without doubt given many advantages to the workmen, found from the same obstructive feeling, but very slow introduction.

"In 1851, the first round frame was put up in Saxony. This was the English frame, as well as the French one of rather earlier invention. These were followed by other improvements, which were used with greater or less results. With the introduction of these frames, this branch of industry has entered a new phase; inasmuch as the manufacture is partly changed from hand weaving, to working by machines moved by steam power.

"Respecting the course of the trade, especially during the past year, 1863, the hosiery business has certainly suffered the most from

the cotton crisis, of all the various branches of the great cotton industry. Not only has the raw material risen to a price hitherto unknown, but also the principal market for wrought goods has been in great part closed, or rendered difficult of access, through the American civil war. The nature of the article, as one not subject to the change of fashion, brings with itself, that larger stocks accumulate in the hands of manufacturers as well as dealers, than is the case with 'sampled' and fancy articles, such as dress goods, laces, &c. These stocks, with the increasing dearness of the material, pressed so much on the home and export markets, as to make it quite impossible to raise the prices of manufactured goods in proportion to the rise in raw materials; so that as the few stocks of yarn came to be worked up, more and more frames entirely ceased to be employed. And although manufacturers and 'factors' (bagmen) exerted themselves to the utmost to find employment for the workmen in 1862 and early in 1863, it became a question of self-existence; because it was not possible to make new goods to come under old selling prices; a fact which must exert its due influence.

"The tables at the close of the report, giving the number of frames with and without employment, shews the extent of this stagnation of trade in a sorrowful manner. The demand for special articles, such as all kinds of gloves, fancy striped hose, &c., which from their very nature cannot be put largely into stock, has somewhat improved this state of things; and work has been given out for a pretty good number of frames. The prospect of the continuance of this is only exceptional and the most hardly pinched districts, Chemnitz, Schopau, Stollberg, &c., have had but a small share in this improvement, as in these districts staple articles are principally made, with which the market is completely glutted.

"The building of the Chemnitz Annaberger Railway, has helped to mitigate a great deal of distress in these districts. Those who were strong enough found employment till December; and *were enabled to earn* 1*s.* 3*d.* *to* 1*s.* 6*d.* *daily; which is three times as much as could be got by working in the stocking-frame; upon which, by many hands, not more than* 2*s.* 6*d.* *to* 3*s.* *a-week could be earned, including the assistance of wife and children in seaming and spooling the yarn. Even on wide frames and better paying articles, a diligent workman could scarcely earn more than* 5*s.* *to* 6*s.* *a-week.* Under such circumstances, the fair earnings of a Saxon stockinger, being under the average of other employments even of day labourers, it was only natural, that more and more hands left the trade, and sought after other work, returning no more. This falling off is not in the least reduced or covered by younger hands being bred up to the trade; for the 'Guildbooks' shew, that very few learners have entered it. In times of good trade, the scarcity of workmen will make itself felt powerfully; and points to the necessity of altering the present deficient mode of manufacturing and carrying on the trade.

"If we seek into the causes which have kept down the wages of stocking-makers during the last ten years, in opposition to the general continued rise in the necessaries of life and in the wages of other hand labour, we shall find them to be as follows: In the successful efforts of England through the adaptation of power machinery, and improvements of hand frames to increase the power of production, and

thereby to paralyze the effect of the cheapness of Saxon labour, and in the slowness with which our trade has followed these improvements. In England also, they who continue to work on the old small hand frames (now to be designated imperfect) earn less than day labourers; but the new improvements and system of division of labour, supported by larger capital, found quicker entrance there.

"A number of iron (probably unremunerative) frames were introduced from England in 1862, in order to make use of our cheap labour. What profit this will produce to those introducing them, it is not necessary to investigate here. But it has so far an interest for the Saxon trade, in that it teaches the workmen how to work on English frames, and in English styles. In times of brisk trade, this undertaking, which has previously been tried on other sides, would have been unsuccessful, owing to the unpliability of the workmen, but the present scarcity of work makes it possible without any great sacrifice. [This refers to the undertaking of Lowe and Co. to introduce English frames.—TRANS.]

"Further, this low rate of wages is consequent upon our system of domestic labour; according to which, almost every workman is his own master, and owner of the frame he works in, and sticking to that which is old, will sooner make work he is accustomed to at a cheaper rate, than learn new methods of manufacture. The means are wanting to most of these people, for they do not reckon anything for repairs or amortization [wear and tear], and become ultimately poor, pressing upon the market their cheap, and certainly often very inferior goods; so that it is difficult, even with improved machines but paying better wages, to compete against them in the market of the world.

"This is the last struggle between purely hand labour and power machinery, whether it be self-acting or requiring the guiding assistance of the hand. This state of things may last a number of years, till the old small frames are used up, and the number of hands working such frames is reduced. These last will, through improved machines, be enabled to produce a greater quantity of goods than the present larger number of workmen; but they will also earn better average wages than now; and in periods of depression, to which every branch of trade is subject, there will be fewer breadless workpeople than we see at present. Already those hands who work at power frames, or on the improved [Heynig] patent ones, earn more than on the small hand frames, and have had during the present crisis more constant employment.

"The more the manufacture is transferred into closed establishments [factories], which through the superiority of power frames must undoubtedly take place, the better will be the condition of the workpeople; and, as a rule, the earnings will be higher than now. The owner of a factory has much more interest in keeping his machinery fully going, than the present manufacturer has to keep employed a number of frames *not his own property*, and upon which he cannot rely when he wants goods, and consequently leaves them to take care of themselves when he is not in want of their production.

"It is true that on many other sides, besides that of the workmen, this decay of home industry, from the increasing development of power frames, is to be regretted. Especially from the moral stand point, it is really to be deplored. These power frames, however,

having been once invented, are without doubt the only means whereby this branch of industry can be retained in the country. We do not wish to see a repetition of the experience which has fallen upon the ribbon trade, and partly also on the cotton printing branch. That the perception of this is making way amongst manufacturers, is proved by the increase of power frames during the last few years. There existed according to the *Journal of the Statistical Bureau*, Dresden, Nos. 3 and 4, in one district of the Saxon stocking trade:—

	In 1861.	End of 1863.
Of English round frame heads	3798	4258
Of French ,, ,,	137	303
Of wide power frames	30	49
Of stitching machines	395	1325

The number of the previous, as well as present existing [wide] walzen [the general term for ordinary wooden hand frames], with patent narrowing machines for making cleared [fashioned] goods, we have not been able to ascertain; but, according to all enquiries, they have considerably increased in number, as many have had the narrowing machine added to them. Of hand looms, a total of 85 has been notified to us as being new made, and they all belong to this category. When we take into account that all this increase has taken place in 1862-3 only (the two worst known for many years in this branch) it shews doubly how the necessity is recognised, not to remain behind the times.

"Experience has also taught us, that Saxony can compete in this field with success against her rival England. For on the one part our spinners have made sufficient progress not to leave us behind in our yarn materials; and on the other, the wages and various expences in bleaching, trimming, &c. (excepting coal, where steam power is employed) are lower than in England. Although the 'round' frames till now introduced, have only been used to make the cheaper sorts of hose and half-hose, shirts and pants, *i.e.* cut goods, there is a prospect that a new frame brought from England and patented for Saxony, will be able to make 'cleared' [fashioned] goods at a cheap rate [viz. Paget's patent, bought by Wex for Saxony]. There are, it is true, already frames at work, that make faultless narrowed stockings by power [wide fashioning frames of Mark Mellor], but they are so expensive, as only to compete with difficulty against hand labour the interest and other expences bringing up to too high a price, the otherwise cheap product. Their introduction has, therefore, not been continued. On the other hand, there has been a considerable increase in the wide power *rib* frames, which make elastic ribs for half-hose, socks, pants, and shirt sleeves, &c. [chiefly Hine and Mundella's construction]. The quality of Saxony hand made ribs, is far behind those of England and France. Some villages, specially employed in making such ribs by hand, from wooden ribbed frames, have suffered severely in consequence, and have, by alterations of frames, betaken themselves to other kinds of [hosiery] work.

"An essential impediment to the quick and general adoption of power machines, will be found in the low development of machine building in this direction. Only a few smiths' shops, and with insufficient means, are employed in the building of such frames; and

the want of such an establishment, has led several manufacturers to use their own shops for building and repairing their own machinery.

"From the importance of the whole of this branch of industry for our smaller 'Fatherland' [Saxony], may the attention of his Excellency the Home Minister be directed to the question—*should not schools be founded, such as already exist in the spinning and weaving trades, for the technical education of young people who propose to follow the profession of stocking-making?* The want of a 'stockinger school' of the same kind as the school for teaching weaving (webschule), will be felt in a most lively manner, when the manufacture is carried on in factories where overlookers will be required, and frames of various constructions must be in use. The following tables give a bird's eye view of the frames employed in the whole Chemnitz branch [being the district represented by this chamber of commerce].

"These tables were compiled in the autumn of 1863, with the assistance of the Behörden (government authorities), and they shew what means of manufacturing are at the disposal of the trade, when business is good; and also the great extent of the present shortness of work; and in which districts the suffering is the greatest. About 18,000 hand-frames were standing; consequently so many workmen were compelled to seek other than their usual employment, besides the seamers and winders dependent upon them, losing the means of earning their daily bread.

"It must, however, be stated that in times of good trade, a considerable number of frames, particularly in the higher mountainous districts, are always unemployed in the summer months; their owners being also joiners, builders, field-labourers, &c., and during fine weather follow their other employments. The number of these only half-employed frames is about 2,000 to 3,000 in the whole district. The tables also shew that the manufacture by power looms, in the present abnormal state of things, is better able to struggle against unfavourable circumstances, than hand-labour; inasmuch, as a greater per centage of power frames were kept employed, than of hand-frames, though the most miserable wages were paid on the latter.

"The 'ketten frames' (at first 60 inches, now built 120 inches wide, and which are constructed on the plan of English warps, and used for making webbing for gloves) have been, in spite of all calamities, the best employed, and at good wages; producing cotton and woollen pieces, from which cut gloves are made, in the same style as kid gloves. The sewing of them has given considerable employment; and women have been able, on this work, to earn more money than the men; as is also the case in the 'gorl embroidering, carried on in the higher mountains.' (These frames are well constructed; built at Limbach, and are rotaries).

"We reckon that the mere wages of the hands employed on and through the 'ketten' frames in winding, working frames, cutting, stitching, dyeing, trimming, and embroidering amounted fully, in 1863, to 500,000 thalers (£75,000), of which two thirds was earned by females. No other kind of frames can shew such a result. Limbach is the centre of this kind of work. For a long time the products of the 'ketten' frames were sold exclusively for European use, and principally at the fairs; but for some years past they have

forced their way into the export trade to America, and into consequently increased extension."

Abstract of the Table of Hosiery Machinery in the whole Chemnitz or "wood-frame" district, as given with Report of Chamber of Commerce, 1863:—

"In Rochlitz country—wood plain frames:

	Total.	Going.
Bingstadt	1678	454
Mittwerda	342	118
Penig	434	151
Rochlitz	58	17
	2512	740

"In Chemnitz country—

Augustenburg	418	139
Chemnitz	6227	3776
Frankenberg	118	42
Limbach	2473	1311
Oederau	13	8
Stollberg	4992	1516
Zschopau	1822	642
	16063	7434

"In Zwickau country—

Johangeorgerstadt	10	5
Remse	202	60
Schellenberg	4	1
Schwarzenberg	16	4
Wildenfels	256	126
Zwickau	17	7
Crimitzschau	8	5
	513	208

"In Annaberg country—

Annaberg	127	41
Ehrenfreidersdorf	1560	258
Geyer	54	19
Grunhain	86	11
Johstadt	7	1
Langenfeldt	122	20
Marienberg	104	41
Oberwiesenthal	40	12
Wolkenstein	781	95
Zöblitz	75	31
	2956	529
"In Schönberg	4834	2300

"Total of wood hand-frames, 26,378; of which were employed and making *plain*, 11,211; besides which, there were wood *rib* frames,

424, of which were at work, 218; and iron hand-frames, 99, of which were at work, 79.

"Of 'ketten' frames .	495,	of which,	at work,	413
Of French round frames	303	,,	,,	131
Of English round heads worked by hand	1774	,,	,,	1066
Ditto ,, by power	2484	,,	,,	1037
Of wide hand power	21	,,	,,	10
Of wide steam power	28	,,	,,	20
Of stitching and embroidering	1325	,,	,,	881

"The whole population of the above district, at the last census, was 650,445.

"The total value of the before-enumerated frames *under present circumstances*, and not reckoned according to what they cost making, would come about as follows:

	£	£
Hand frames, cost, wide and narrow, £7. 10*s*. to £12; 26,878 at £4. 10*s*. . .	120,951	
Iron hand frames, £27 to £30; 99 at £19. 10*s*.	1,930	
Ketten, £30 to £37. 10*s*.; 495 at £27 . .	13,365	
Rib frames, £11. 10*s*. to £12; 424 at £7. 10*s*.	3,180	
		139,426
Power frames:—French round frames, cost £60 to £75; 303 at £37. 10*s*. . . .	11,362	
English round head, £6 to £7. 10*s*.; 4,258 at £4. 10*s*. . . .	19,161	
Wide power frames, 49 at £150 . .	7,350	
Stitching and embroidering, £4. 10*s*. to £6; 1,325 at £3	3,975	
		41,849
		£181,275

To which must be added the value of gearing, driving tackle, winding machines, and utensils used in trimming, pressing, &c.

"In a good state of trade, with all frames fully employed, the following quantities of yarn would be required:

	lbs.
26,977 wood and iron hand frames, 5 lbs. weekly . .	134,885
495 ketten frames, 30 lbs. weekly . .	14,850
424 ribbed frames, 5 lbs. weekly . . .	2,120
Total hand frames . .	151,855

	lbs.	lbs.
303 French, 50 lbs. weekly . .	15,150	
4,258 English heads, 10 lbs. weekly .	42,580	
49 wide power, 15 lbs. weekly . .	735	
		58,465
Total weekly consumption .		210,320

Say 200,000 lbs. a week, or 10,000,000 lbs. per annum, of which Saxony furnishes a full half, the Zollverein and Switzerland a quarter,

and England a quarter. In the past year not more than a third of this quantity has been required, owing to the number of frames standing, and the reduced hours of labour.

"Turning to the kinds of material employed, about nine-tenths has been cotton yarn. During the last few years, the working of woollen yarn has been more general, being used for gloves, and also partly for stockings and shirts. In finer qualities of woollen under shirts, hose, and half-hose, the Saxons have been in competition with Thuringian [Apolda] manufacturers for some time; and lately stout heavy articles have found entrance into German and general consumption. This has employed many frames that, in bad times in the cotton branch, would have remained unemployed. We much want the important 'carded wools' from long stapled common wools, which are spun nowhere in Germany, but which have hitherto given the predominance to England in common woollen hosiery. A material much used in England, merino yarn, a mixture of wool and cotton, has been but little used in Saxony, for hose, half-hose, pants, shirts, &c.; the spinners of such yarns being wanting, or only accustomed to spin for weaving purposes; and the finishing of the merino wrought goods is attended with difficulties. Besides, the English manufactures are so extended in which this article is used, and are so firmly founded, that it makes it doubly difficult to struggle against them, and make a position in the markets of the world. Linen yarn occurs only exceptionally, being partly replaced by 'Scotch twist' [Lisle thread], which is gaining the upper hand, and furnishes a more even web. Organzine silk is used only in gloves, and then almost always in mixtures with other materials. *Floret* silk, which was formerly much used for gloves and stockings, has found latterly but little use; it has died out.

"With respect to the returns of the trade for the year 1863, it may with safety be assumed, that they have been greater than the amount of goods made, for the stocks on hand are smaller than at the beginning of the year. But the selling price not being anything like in proportion to the cost of newly made goods, the manufacture of the latter, beyond the demand, has been kept down as much as possible. The cost of goods at this time was no criterion of the selling price. Holders calculated averages between the cost of old and new made goods, and offered them at prices, which they modified according to their engagements, and opportunities of lightening stocks by sales. The depreciation of the American currency pressed more on sales and on all business to America, than the prices asked on this side; and stopped all sales of better goods to that country. With diminished stocks, any return of brisk demand, will, it is hoped, raise the present extremely low rate of wages. It will find considerable disorganization. Many frames will have become useless; many, especially of the younger hands, gone into other employments: so that the pecuniary loss to workmen of wages, and to the manufacturer of his profits in trade, will not be the only evil befalling this branch, through the cotton crisis.

"In conclusion: It is a proof of the care, prudence, and solidity, with which the members of the Saxon hosiery trade have conducted their business, that in spite of two years so pregnant with events, only one or two small failures have occurred; the causes of even these,

are not to be attributable to the unfavourable circumstances of the times. The capital employed in the trade has rather diminished, we believe, than increased, in the years 1862 and 1863."

In order to bring the official account to the latest possible time, extracts from the report of 1864, also drawn up by Mr. Hahmann, President, and presented as before, are appended:—

"There is no improvement of the hosiery trade in this district of Saxony; the returns are somewhat larger, but the number of unemployed frames is much increased, and is now beyond 18,000. In the district of Annaberg, the brisk trade in embroidery of muslin and lace, has enabled the women to earn good wages, and the men have done the household work. Webs for gloves have been in request; as also goods of coarse gauges in fashioned work. Stockingers wages have not increased, 4*s*. 6*d*. to 6*s*. is considered good pay. Hands are still rapidly leaving, and that finally, sales are making of wood frames at 10*s*., £1. 15*s*. to £3. 15*s*. a-piece. Some from mere necessity; others from despair of any improvement. There has been no symptom of a disposition to riot, either here, or amongst weavers in Silesia. Round frames are fully replacing the cut goods made by hand; and coming lower in price, press on the demand for narrowed goods also.

"Power frames are building to meet the expected deficiency of hands for making narrowed hose and hoped for improved demand;" (these are constructing partly on Paget's, and partly on Woller's plans; of the latter little is as yet known) "but the want of suitable framesmiths will prevent their quick extension. Smiths accustomed to other kinds of machinery, are not equal to the construction of these hosiery frames; at least not until they have had experience amongst stocking weavers. And *again, reference must be made to the necessity for setting up 'trade or technical' schools, to teach how to construct frames, and how to work them.*

"About two-thirds of the English and French round frames have been continued at work, mainly with the view of keeping them from injury, to which they are so liable. The capacity of all classes to produce, has been much lessened by the very inferior yarn now used in making hosiery. To keep down price has been the main object, both in yarns and goods. So to work all Surats has been common; except for retail home trade, which would pay the value of the good old quality. These remarks apply to hose, socks, pants, and shirts; but of gloves, the produce of the 'ketten' (warp) frames, a more favourable report can be made. In these there has been a lively trade, old machines have been improved, and better new ones built, to make hay while the sun shines. Limbach is the chief seat of this branch. There, 22 ketten frames have been greatly improved; and 38 new ones, 60 Saxon inches wide, to be worked by hand, and 80 iron 120 inches wide for power, have been constructed. They would all be made of the latter kind, were the expence not so great. For with old narrow frames it is not possible to meet foreign competition. On these frames, workmen earn from 15*s*. to 18*s*. a-week; on the old ones only 6*s*. to 9*s*. can be obtained.

"Steam power is now also applied to do all the work in cutting out gloves; indeed to make and finish them entirely from 'tricot' machines; and by the use of stitching machines to seam up, even the fingers neatly; and then by the 'stepp' machine, to embroider them in the present styles.

"All these three kinds of machines, are made now in the increasing and fully employed machine building business, at Limbach.

"By these arrangements, glove seamers in the villages are dispensed with, and orders for goods are executed with a regularity, formerly unattainable. The glove trade from the regular hand frames is small; but it certainly offers better work, than that in stocking making. These gloves are worn chiefly by the poorer classes.

"Although for German and foreign trade, great caution was used by purchasers; and American currency still fell in value; yet the Saxon hosiery business was on the whole improved in the early part of 1864. In the latter months, buyers expected to see every fluctuation in the Liverpool market for cotton, reflected in the prices of the goods here; although wool had risen 300 to 400 per cent. and goods not more than 100 per cent. Great confusion in prices and offers has been the result. The German retail trade, hitherto supplied from France, is yearly more cultivated. Thread hose and half hose; and, favoured by fashion, fancy striped goods of all kinds in cotton, merino, and worsted, are in fair demand. This branch should be cultivated, for it pays better wages, and trains accurate workmen. A factory has been set going, in which fancy work is made, on hand frames; these better paying articles it is likely may be thus profitably produced. For making unbleached staple goods, it has hitherto not been found, that the production by domestic industry, can be thus replaced to profit.

"The effect which the French treaty of commerce may have is doubtful. It is a curious fact, that of cotton hosiery, which constitutes the bulk of the manufacture and consumption of both countries, not one word is spoken. It must therefore be looked for under unnamed articles from cotton, with a 15 per cent. duty."

Appended is a table added to the report of 1864, by the chamber of commerce:

"Weekly earnings in stocking making:

	1860. £.	s.	d.	1864. £.	s.	d.
Chemnitz, males, hand frames	0	3	9	0	3	9
,, ,, power frames	9s. to 12s.			1	4	0*
Zwickau, males, hand frames	0	6	0	0	7	6
,, females, hand frames	0	4	6	0	5	3
Annaberg, males, hand frames	0	4	0	0	6	0
Mittwerda, males, hand frames, with lodgings	0	4	0	0	4	6
Zschoppau, males, ,, ,,	0	3	0	0	2	6
Loessnitz, males, ,, ,,	0	3	0	0	2	6
Limbach, males, hand frames	0	6	0	0	12	0
,, ,, power frames	0	4	6	0	5	0

* (Probably on patent rotary frames with ribbing or narrowing tackle.)

	1860. £.	s.	d.	1864. £.	s.	d.
Stollberg, males, hand frames .	0	6	0	0	4	0
,, males, power frames .	0	6	0	0	7	6
,, females, power frames .	0	3	6	0	4	0
"And in smaller towns and villages:						
Men earned in hand frames . .	0	5	3	0	5	9
Women ,, . .	0	2	0	0	2	0
Men ,, power frames . .	0	6	0	0	9	0

The following remarks explanatory of the above table are from a private hand:—

"From 1860 to 1864 was a time of greatest depression ever known to the hosiery trade in Saxony.

In Chemnitz itself there is now very little work made by hand. Only made in factories, as Hecker's, Wex's, Starker's, and one or two more.

"In Zwickau, very little hand work; it is the great coal field; and more is made in mining than stocking making.

"Annaberg gives embroiderers better wages, than stocking makers can gain.

"In Mittwerda there are not many frames.

"The wages are most depressed in Zschoppau, Loessnitz and Stollberg; which are in the principal district where fashioned hose, half hose, &c., staple articles, are made from narrow and wide hand frames.

"Limbach is the district for fancy striped and fine thread goods, and gloves.

"At Stollberg, Mr. Woller makes round hose very largely indeed."

A machine for making looped hosiery articles, constructed on a novel and ingenious plan, was devised by Mr. Jacob Albert Eisenstück, of Chemnitz, and patented in England in 1860, No. 1132. This gentleman's father was an eminent hosier at Chemnitz, where, having retired, he is succeeded by his very clever son, this patentee. It is for machinery operating on a new arrangement of needles, whereby widened or narrowed cylindrical hosiery is made without seam, in cylindrical or narrowed parts. Without plates a very limited idea of its operation can be furnished.

In the specification it is stated that two sets of needles are arranged on parallel bars. The needles are placed inwards; and these four sets of needles form a four-sided figure or parallelogram. The fashioning is effected by causing the fashioning needles to move to and fro and between the two first-named rows of needles, by suitable means. The patentee prefers to produce the narrowest part of the fabric first. The fashioning is caused by the action of the same

power, as that at work producing the knitting fabric. So long as the parallelogram remains undisturbed, a perfectly cylindrical web will be produced. When the fashioned part of the fabric is to be made, then the fashioning guiding apparatus comes into play. The precise pattern of the stocking or other article to be made, is first set out on a pattern wheel. Then the wheel with the knitting machinery is caused to rotate. The pegs and projections operate on a rachet wheel, which by cranks and other mechanism, acts on both sets of fashioning needles, causing them to recede from each other, to produce fashioning according to pattern. The to and fro action of the fashioning needles may be produced in other ways.

This machine has been as costly as it is ingenious, and has been the result of many years of laborious effort. It is perhaps too complicated at present for practical purposes; but if the principle of construction is sound, it may receive such simplification as shall render it effective.

In addition to the concluding remark in the explanatory statements above given, we are informed that Mr. Woller, of Stollberg, has just got out an invention for working a ribbing frame by power. It is a very clever one. It makes the welt, the slack course, and the fine course all by its own action, and without stopping or assistance from the workman. At present, they make four ribs at once; and one man can manage three frames. He is building them, and selling them to manufacturers.

Each needle has its sinker, and divides well, and the machine works well. At present Mr. Woller works them slowly; but intends to put them to the higher speed of which he believes them to be capable; and by which he calculates one man would be able to turn off 300 dozens of ribs, 4½ inches wide, weekly.

Mr. Woller's hosiery concern is one of the largest in the world. He makes often 20,000 dozens of round hose in a week, and can do more. He does not bleach his own goods, but trims and boards them. The town of Stollberg, as well as his own works, he lights with gas. The goods produced by this house find their way into all parts.

The goods made in Saxony upon iron frames have obtained a place in most markets of the world. They are principally sold through four or five manufacturers, whose business is carried on at Zeulenroda. They are made on the same system as that practised in the

Chemnitz district; fine yarn is used on stouter gauges, made extra wide and short; and then boarded up to the requisite length by the stockinger. The hose are consequently hard and non-elastic, but still firm and clothy.

In this district the workmen generally are very industrious, but poor; and, as a rule, work direct to the manufacturers. Each master has one or two apprentices, and sometimes journeymen; but since the abolition of legalized guilds, the latter work mostly on their own account. The quantity of work turned off by them in a week is, about four-fifths that produced by English frame-work-knitters; but they do not knock the frame about so much. They are not so easily changed from making one size to another as the English workmen, but they are docile and contented. They often make up for absence from work at one time, by long hours of labour at other times. In this respect they are quite the counterpart of their brethren in England.

In this iron frame district there are but few factors; the masters working to the manufacturers in Zeulenroda and Pausa. Journeymen and apprentices lodge with the masters; and the former pay weekly in Pausa 1*s.* 5*d.* for lodging and coffee in the morning, and a dinner of broth, potatoes, and a little meat, and of coarse black bread. The evening meal, washing, &c. they have to find themselves. Good black or brown rye bread, possessing more real nourishment than the best wheaten white bread, costs 1*d.* per lb. Meat has risen 1*d.* per lb. within the last ten years, and is now for veal, 4*d.* to 5*d.*; beef and mutton, 5*d.* to 7*d.* Potatoes are 3*s.* 3*d.* to 4*s.* for 100 lbs.; coals, 1*s.* 8*d.* to 2*s.* for 100 lbs. Most of the master frame-work-knitters cultivate potatoes, cabbages, &c. on a piece of land of their own. An apprentice gets no wages until he makes a dozen pairs of hose in a week, and has to pay nothing. When he makes over a dozen he receives 1*d.* or $1\frac{1}{4}d.$ a pair, according to quality, &c., and has free board and lodging.

For making 30-gauge stockings 21 inches long and 9 inches round feet, round heels and full narrowed,

made of No. 40, three thread yarn, the master receives 5*s.*, the journeyman 3*s.* 4*d.* per dozen, and may produce 18 to 20 pairs in a week. The master pays seaming 4*d.*, frame rent 6*d.*, and for fire, light, needles, winding. The rest is for himself for lodging, &c. The above price is the highest ever paid for this article; the lowest was paid in 1864, viz., 3*s.* 6*d.* per dozen to the master.

A report of the chamber of commerce in 1864, for the Plauen district contains the following table of stocking-frames (then at work most probably), viz.:—

	Masters.	Journeymen.	Apprentices.
Plauen	12	—	—
Pausa	227	82	19
Mühltroff	71	36	17
Brambach	97	30	20
Adorf	26	5	—
Oelmitz	3	1	—
Barenwalde	106	—	—
	542	154	56

Making a total of 752 frames.

The result of careful inquiry in this district, in 1866, upon this subject, compared with the amounts of goods believed to have been produced and delivered into the hands of manufacturers and bleachers at Pausa and Zeulenroda, is, that the number of *iron* frames are, at least, in Zeulenroda, 1000; Pausa, 400; Aurna, 150; Schleitz, 120; Gefell, 100; Herschberg, 100; Leichtenberg, 30; Tanna, 15; Triptes, 15; Hohenleube, 50; Mühltroff, 120; Brambach, 100; and various small villages, 100; making a total of 2,300 narrow frames; which, together with 40 wide frames at Pausa, and some scattered wooden frames, comprise the actual hosiery machinery in the Voigtland district.

The entire numbers of Saxon frames stated in this paper, are 27,300 narrow of wood; 2,400 of iron narrow, and 100 wide; 500 'ketten' wide; 300 French round, and 4,260 round heads—a total of 34,860 frames; and 1,325 stitching machines are known to be employed by them.

The Chemnitz hosiers, as a rule, do not own hand-frames; only round or power ones. The factors, and the men themselves, are the owners of the hand frames. These factors are a very respectable and fairly educated class of men. Most of them, before the cotton crisis, bought their own yarns, and then sold the goods to the Chemnitz hosiers. During that crisis, many of the weaker and smaller were obliged to work for wages, taking the yarn from the manufacturer. But now they are returning to the old system. There are factors who

have held 10,000 to 20,000 dozens of unfinished goods in stock; and one or two have held even larger stocks than those for a time. This system places the Chemnitz hosier in a very favourable position. He need not hold an unwieldy body of machinery, nor a risky stock of yarn, nor any great stock of goods; therefore less capital is required in his business. Still, the larger and older houses, having considerable capitals at their disposal, make their own ranges of numbers and prices of all kinds of goods; which being in stock, are ready for finishing and sale.

The great object too much kept in view by Saxon hosiery manufactures, has been cheapness. Everything else seems to have been subordinated to this. The goods are made shorter than in Nottingham; finer numbers of yarn being worked on coarse gauges, and consequently the work is harsh, with little elasticity. In England, the governing principle of payment is by *width*, in Saxony by *length*. On the Saxon principle the difficulty of getting goods made regular in quality is increased. For instance, a stocking intended to be 25 inches long, $5\frac{1}{4}$ inches wide, and with a 9-inch foot, is made about 22 inches in length, 6 inches wide, and $8\frac{1}{2}$ inches in length of foot. By manipulation in boarding and trimming, it is brought to somewhat like the required size. On this system the goods will vary, and the wale is liable to be injured, and the qualities after all must be assorted from each other of goods made under the same name.

In Saxony, the bleacher uses less soap than is used in England; his charge is proportionably less, no doubt; the goods, however, lose fulness in hand by it. More time is allowed by him for the operation. He does not dress and finish them. Most of the large manufacturers dress and trim their own goods.

Mr. Wilhelm Vogel, a native of Apolda, now a merchant of Chemnitz, favours us with the following notes on the hosiery trade of Apolda:

"This manufacture was planted there about 300 years ago by Netherlanders, driven from their own country by religious persecution. During this interval it has prospered, produced knitted and machine-wrought

striped woollen stockings, caps, shirts, pantaloons, gloves, &c. These found an outlet principally at the fairs of Leipsic, Frankfort, and Brunswick. A few houses have had connexions in Holland, Switzerland, and Italy. In 1830, Mr. Vogel was the first to travel in this business through North Germany and Holland. This he did on account of the house of August Zuimmermann. The more important advance in the hosiery trade at Apolda dates from 1834, when the Zollverein was established, and is principally owing to the activity of the brothers who constitute the firm of Christian Zuimmermann and Sohn, whose production included, besides the before named articles, fancy woollen goods of the most varied kinds, which gained a market in every part of the world. Their returns probably equal those of all the other hosiers at Apolda together. Apolda had about 4000 inhabitants in 1830; now there are about 9000; it contains a large number of manufacturing houses, shewing the prosperity of its trade."

The following is extracted from the *Weimer Times* of 18th March, 1866. The article is headed "Thuringian Industry, 1864":—

"One of the most important branches of the industry of Thuringia is the woollen trade and branches connected with it. As the Thuringian spinning mills had full employment in 1864, so was the manufacture of woollen stuffs and hosiery fully carried on. At the end of that year a reduction in prices took place, which was particularly felt at Goesnitz and Greitz, and in consequence many stocking-frames were thrown out of employment in Goesnitz. At Apolda manufacturers of woollen hosiery have been fully employed. During the previous four years an average of 15,300 cwt. of raw materials were used in making 13,000 cwt. of finished goods." [Hildebrand's *Annual for Political Economy and Statistics*, gives the yarn required at 25,000 cwt., on an average of the value of 3,750,000 thalers, £562,500.] "Of these 13,000 cwt. of woollen hosiery the Zollverein takes 5000; fairs and markets, 1850; free cities, 500; Mecklenburg, 200; Schleswig Holstein, 150; Norway and Sweden, 300; Denmark, 200; Switzerland, 600; Italy, 900; Russia, 300; England, 50; North Spain, 25; Turkey and Danubian principalities, 350; Holland, 950; Belgium, 25; South and West America, 1,200; other non-European states, 400. This 13,000 cwt. of hosiery represents a value of £412,750. The yarn employed is 6,600 cwt. from England, the remaining 6,400 cwt. is German spinning chiefly from the Thuringian mills of Jena, Stadslin, Muhlhausen, Gotha. Also from Saxon spinning mills. The manufacture of this hosiery employs 900 to 1000 frames, and in Apolda about 150 machines. There are 2000 to 3000 females employed by Apolda

firms, who are spread over all the large towns and villages through the neighbouring district."

According to other information, these statements seem to be taken too low.

The prophecy in the report of 1863, that a deficiency of hands would make itself felt so soon as the demand for the United States returned, has not only been fulfilled, but to a much greater extent than any one seems to have anticipated. Wages have risen since March, 1865, 50 to 100, and in some articles, 120 per cent. They are now higher than ever known, by the oldest manufacturers. This, with the high price of yarns, brings goods to an enormous cost; and makes it in the judgment of the most experienced hosiers, not a little dangerous to manufacture.

In a former chapter prominence has been given to the important and difficult subject of trade regulations, whether by a chartered company, trade combinations of masters and men, or courts of conciliation; we therefore close this account with a description of the system of management instituted in the German guilds or trade companies, under which this business has noiselessly advanced to its present dimensions and that have been but recently laid aside as to the exercise of any authority from the state.

The guilds which were constituted in Saxony, do not now settle trade differences between masters and men, nor do they amongst the men themselves. Their legal power to do this was withdrawn in 1861. Formerly, the workpeople were obliged to belong to them; since that year they only exist in Saxony as private societies, and not as guilds. To the English frame-work-knitter, the history of one of these authorised societies may be interesting; that of Pausa is given as an example. It was founded in 1750, by 20 stocking-makers who were masters, having 22 journeymen, and 14 apprentices. Its highest numbers were attained in 1850-60, just previously to its cessation as a legalized body; there being then in it 81 masters, employing 129 journeymen, and 174 apprentices. It was originally established in order that being confirmed by authority, journeymen and apprentices taught their business at

Pausa, might have recognition and consequently find employment, when on their appointed journeyings through other German districts and States; and thus not be compelled to return back again, from not having been acknowledged as members of a guild. The term of apprenticeship was four years; on finishing which, the youth remained a journeyman, till of age at twenty-one. He then was obliged (according to the ancient and universal trade custom in Germany,) to travel ("wander") for two years; after which, on returning home, he could, if he desired it, become a master, after giving six months notice, and proof of capacity, by making a "master piece of work, consisting of one night cap, one pair of gloves, and one pair of men's hose with shapes." These had to be made in the presence of the president (*obermeister*) of the guild, his assistant, and two deputies as well as a deputy from the Town Council. During the operation, these five functionaries ate and drank at the candidate's expence. As each article required was begun, it was sealed with the guild seal by the president, to prevent deception. A fee of 13*s.* 3*d.* was paid on the entering of apprentices, and another of 19*s.* on becoming a journeyman. At first a feast was given by a newly made master; but as the number became large, this was commuted into a payment of 34 thalers, or £5. 2*s.* by each new master to the fund.

These fees, including a payment of 6*s.* a year by each master, constituted the fund of the guild. This body had the power to cross out the name from their register, of any member convicted of stealing. In cases of quarrel or dispute between masters and journeymen, the president decided the case.

Each guild had a large chest called the "*Lade*"; usually a handsome carved piece of furniture, with drawers for money, guild-book, and other documents. The president held the key, and kept the books, register, &c. This '*lade*' was an object of great respect; all meetings were held before '*open lade*'; when the president had opened it, the members took off their caps, ceased smoking, and were obliged to behave in all other respects, decently and respectfully.

It was before '*open lade*', that new masters were admitted, after solemn examination of their 'master piece of work.'

Each journeyman on setting out upon his wanderings, received a '*wander-buch*' (a travelling pass-book) from his guild. It is now issued from the police office in larger towns, and by the ordinary authorities, in lesser places; and every workman must have his pass-book. The police write in it "left this town such a day." The owner on reaching another place, must present himself to the police authorities, and be registered. Foreigners who settle for some time any where in '*Father land*'(Germany,) but do not become naturalized, must obtain a 'permission ticket' to live there; by which plan every one is under the observant eye of authority.

On the death of a husband or wife, belonging to the guild, 18*s*. was paid out of the fee fund; and so much for a deceased child; in case of sickness, assistance was given; and occasionally money was lent to a master for special purposes. Any balance in hand was from time to time either divided or expended, on a general feast of the members.

This account, with minor differences in customs of various trades, is applicable to other German guilds, besides those for hosiery.

Since it ceased to be compulsory for Saxon stocking-makers to become members of guilds, complete statistics cannot easily be obtained, as will appear from the tables with which the account of the iron branch of the manufacture is closed.

CHAPTER XXXI.

MACHINE-WROUGHT HOSIERY.

It is difficult to say when or by whom the stocking-frame was first taken to the *United States of America*. Before 1775 there were 150 of these machines at German-town, and near the Brandywine. They had increased to 200 in 1815, and so remained as far as was known in England up to 1835. Since then there has been an interchange of mechanical inventions, beneficial to both countries. Several clever hosiery frames of American construction are at work both there and here. Our brace, warp, and bobbin net machines, have been sent over thither.

We have received the following statements, which if not over-estimated, indicate such an extraordinary progress as may well command the serious attention of the English trade. They have been compiled by a gentleman conversant with the United States hosiery manufacture:—

"The amount of hosiery annually produced at German-town, is from eight to ten millions of dollars, (£1,600,000 to £2,000,000). These are nearly all woollen, similar to those made by Harris of Leicester. They comprise hose and half-hose chiefly made on *circular* looms; also shawls, hoods, scarfs, nubias, comforters, gaiters, &c. Fashioned hose are made here to a limited extent; a few circular cotton hose and half-hose complete the list.

"New York state takes the lead in the production of shirts and drawers; and manufactures from ten to fifteen million dollars yearly, (£2,000,000 to £3,000,000), of these goods, principally at Cohoes, near Albany, where are the Falls of the Mohawk, affording splendid water power. Ribbed hose and half-hose are made at New Amsterdam, thirty miles north of Albany.

"The New England states have made rapid strides in this manufacture, especially during the war. Massachusetts takes the lead, followed by New Hampshire, both being largely engaged in the Derby ribbed hose trade. These goods are made on Aiken's and Pepper's patent speedy circular frames, producing handsome goods.

In Massachusetts many ribbed goods are made on *hand* frames by Englishmen. Rhode Island, Vermont, Connecticut and Maine, all make hosiery, and the New England states may probably become the centre of the manufacture. It is not possible to estimate the amount now produced there, but it is very large. New Jersey produces from one to two million dollars (£200,000 to £400,000) yearly. The aggregate United States production, exclusive of New England, is from nineteen to twenty-seven million dollars (£3,800,000 to £5,400,000)."

Mr. Joseph Whitworth, the celebrated mechanician and engineer of Manchester, introduced in 1834, an American knitting machine, which had not any of the parts of Lee's stocking-frame in its construction. This frame may make ten or twelve hose at once; but the fashioning by narrowing can only be given by the superintendant to one hose in succession to another. The machine loops stitch by stitch one loop at a time in each stocking, making 400 loops of 18-gauge to 24-gauge per minute, per stocking.

The web is made by a long bar traversing from side to side and back again; on this bar are placed a number of upright hooks at the end of which is a slight beard or kind of 'tumbler.' A description of fixed carrier needle acts for making each stocking, which remaining stationary, laps round each hook in succession as it traverses, and a sort of point enters an eye on the hook, and rising up lifts from behind the loop and passes it over the end of the tumbler upon the loop already made. Thus stitch by stitch making a new series or course of loops.

The hose are seamed in the usual manner. Very hard twisted durable materials can be used on these frames. They were of coarse gauges and produced excellent imitations of the best hand knit work, only to be distinguished indeed from it by their more perfect regularity of texture.

In 1845, there were six frames at work. But from the cost being so much higher than that of ordinary frame-knitted hose, they are no longer employed. The name of Wild has been associated in this country with this invention. Possibly it is that of the American inventor at New York.

In the *Scientific American*, July 2nd, 1860, the following statement appeared:—

"It has long been a desirable object to knit a stocking from top to toe without a seam by a machine, and which would fit the foot as neatly and sit as easily as one knit by hand. This has at last been

accomplished. We have examined four unique knitting-machines of Raymond and Co. at Williamsburg, which knit at the rate of two pairs of entire stockings in nine minutes. One girl can attend four machines, and produce over ten dozen pairs of stockings per diem. Three threads are fed simultaneously on one machine, the needles of which are placed around a circular 'former' or 'cylinder,' that is so actuated as to execute the difficult operations of forming the legs and feet alternately. The devices for accomplishing these results are ingenious and peculiar. The stockings are knit in a continuous web; the toe of one is finished when the top of the other begins; and by drawing out a thread the one is separated from the other. Nominally there is no waste of yarn; the mechanism is strong and durable; and the needles having no catches are not liable to break. The American and European patents for these machines belong to the McNary knitting machine company of this city."

This company took out patents, Nos. 452 and 2421, in England for improvements, in 1860. The second is a new arrangement of the former.

Both are described as being on a circular machine, not having flexible or closing beards, and having their work taken off by stitch hooks. The plans and instruments are very ingeniously devised, and the invention is described as specially applicable to machines which have rotary or lateral motion of needles, controlled for the purpose of giving form to stockings, &c., by means of a rotary studded cylinder or drum (patented in No. 452) to which automatic motion is given, continuous, longitudinal, reciprocating, and rotatory. A switch lever is so constructed and applied as to be thrown out of and restored to position by the action of the studded cylinder. The pressers are so arranged and operative as to admit knitting on immediately adjacent needles. The switch wheel is geared with the needle ring. 'Loopers' are employed and needles are constructed and secured as described.

This company patented improvements on the above in 1861, No. 831, intended to make better fashion and with greater economy.

In the present plan the requisite fulness in the leg of a stocking is obtained from accumulated loops got by knitting backwards and forwards in courses of various lengths, making short or long zig-zag courses as in a gore without seam. By doing this over more or fewer needles, the forms may be varied in breadth as well as length. Modes of lessening breadth in circular work are described. Lock or chain stitches to finish off round work are proposed. The accumulated courses are effected by the cylinder being suitably studded.

An English patent was taken out in 1863, on behalf of Mr. J. G. Wilson, of New York, for an improvement in knitting machines.

This is described as consisting in an apparatus to be used on machines in which several needles are knitted upon at once. Ordinary pressers have a complicated movement. In this invention the same

results follow by using a pad of india rubber to press the work against the upper part of the inside at the back part of the needle bar. The pad is also made to rise from contact with the work just before the rotation of the needle ring in a circular frame, or longitudinal movement of the needle bar in a straight machine, takes place; and remains out of contact during the movement of the bar. As the needles start on their upward movement, the pad descends still further, so that it draws the work and yarn back over the heads of the needles to prepare for the next course. A second pad can also be applied to press upon the work just before the first pad leaves, to hold the needle bar while the first pad is raised. By this means the work is drawn away from the needles as fast as it is done. A divided presser with a series of conductors in two or more sections can also be employed in a circular frame, for closing the beards of the needles when a large number of threads is used to knit at once on several of the adjacent needles. Each piece of the presser and the corresponding part of the series of conductors is so applied and operated upon, that one point in each piece of the presser and one conductor in each part of the series moves radially towards the centre of the ring. An improved stop motion, composed of slides, is also applied, so that in case the yarn breaks a suspended slide drops and brings its tongue into notches, which are arranged so as to produce a longitudinal movement to throw the machine out of gear. Grooves of the depth of the screw head are cut to prevent the shaft from being moved longitudinally further than is necessary.

The production of hosiery holds a high rank in *France*, as indicated by the amount of transactions of which it forms the basis, as well as the great number of workpeople directly and indirectly employed in weaving, seaming, embroidering, and finishing this class of articles. The district around Troyes is nearly assimilated to that of Nottingham, as being the principal seat of the cotton hosiery fabrication. Around Nismes and in the 'Department du Gard' generally, has long been the home of the silk hosiery production. Paris and its environs are celebrated for fancy goods. Frames are, however, employed in upwards of 600 communes of France. The entire number we are not able to state. The chamber of commerce at Troyes was presided over in 1846 by M. Grèau, long one of the most eminent manufacturers of hosiery in that city. This body joined in strenuous efforts to oppose the introduction of free trade into France, to which measure its president also was decidedly adverse. This caused him to draw up a copious and able statement containing, amongst other matters, an account of the extent, employment, and

returns of the hosiery business in that district. The document was compiled from information furnished by official sources added to the personal knowledge of the compiler. This paper received the public approval of the Prefect du Department de l'Aube, and of the Ministers of the Interior and of Agriculture, and may be received as entirely authentic. Though, as we think, greatly in error on the exciting subject of "Freedom of Exchange," yet M. Grèau was a man of great public spirit, and indefatigable in carrying out whatever he deemed to be practical ameliorations in society around him. On referring to this report the prefect remarked, "if such an one had been drawn up each fifty years since the time when the hosiery manufacture was first established there, how much of interest would now be known of its adverse and prosperous times, calculated to instruct the present and guide the future?"

In describing the progress of the business, M. Grèau mentions M. Delarothiere, of Troyes, as one who, if he had been placed in a favourable position, would have been accounted, from the improvements he effected in the hosiery manufacture, as a man of great mechanical genius. Forgetful of himself, he sought only to endow his country with valuable inventions. While prosecuting them he vegetated in obscurity, until his very name was ignored amongst those who had been enriched by his discoveries. In 1828, he produced a machine supplying web equal to that from the English warp-frame; and soon after, a machine for making gloves, replacing those smuggled from England. In 1834, he constructed one for narrowing stocking feet without seams. Twelve French patents for improvements were obtained by him in fifteen years. His system of narrowing frames is spread over France.—To Messrs. Poron frères, of Troyes, is due the introduction of English rotary ribbed frames.

There were in 1846, in the Arondissment of Troyes, 18 cotton spinning mills, with 65,000 spindles, employing 1690 spinners, males and females, and producing 862,500 killos. (1,832,800 lbs.) of yarn worth 2,242,500 f. (£89,660). M. Grèau, gives the prices of coal from *sixty-three* French coal fields. In the district of *Troyes* there are 1495 narrow cotton hose frames, 715 wide pantaloon frames, and 400 circulars, all using cotton; 500 Scotch thread for hose and gloves,

100 cashmere, 200 spun silk, and 100 woollen mittens; 3510 frames in all, 22 to 30 gauge; using 840,660 killos. (1,786,400 lbs.) of materials, and producing goods worth 6,391,000 f. (£255,640). In the district of *Nogent sur Seine* all that were at work were on with cotton, except 100 using wool; 2,000 were making cut-up goods, 800 were wide making shirts, 400 made fashioned hose, and 100 circulars,—total, 3,400 frames, 22 to 27 gauges; using 992,000 killos. (2,198,000 lbs.) of materials; and producing goods worth 6,409,000 f. (£256,360). At *Arcis sur Aube* and its environs there were 1946 making cotton hose, 900 using Scotch thread, 200 cashmere, and 400 spun silk hose and gloves. These were all 30 gauge, and with 240 at *Eperney*, 16 at *Bar sur Aube*, and 29 at *Bar sur Seine*, made up 3,491 frames; using 192,818 killos. (409,738 lbs.); and which produced 4,472,600 f. (£178,900) in value. The entire number of machines using cotton 7,901, consuming 1,880,550 killos. (3,996,170 lbs.), and producing 13,548,100 f. (£541,924); Scotch thread, 1404 machines, using 56,000 killos. (119,000 lbs.), making goods worth 1,482,000 f. (£59,280); wool, cashmere, and spun silk, 1,100 machines, using 58,100 killos. (123,462 lbs.), producing 2,262,000 f. (£90,480) in value. The hosiery manufacture in the *Department de l'Aube* in 1846 therefore employed 10,401 frames, using 1,994,650 killos. (4,238,630 lbs.) of materials, which cost 7,380,271 f. (£295,211), giving 7,270,000 f. wages (£290,800), and producing an ultimate return of 17,292,600 f. (£691,700). There were employed 11,721 men and women, who gained 1·25 f. (1*s.*) a-day, and 21,402 women and children at 0·45 f. (4½*d.*) a-day. The capital laid out in 10,401 frames and buildings requisite, was calculated to amount to 7,779,860 f. (£311,190).

After comparing the quality and cost of the hosiery articles from Saxony in the Berlin exhibition, in 1844, and English hosiery of the same date with those of France, M. Grèau declares his opinion to be that, to meet on equal ground, the price of the labour of the French frame-work-knitter must be reduced 50 per cent., or the price of French cotton yarn, 30 per cent. The weekly wages of the Saxon stocking-maker were stated by him to be 4*s.* to 4*s.* 6*d.* a-week.

We regret not to be able to give an equally extended statement of the production of silk hosiery in the south, or of fancy and other articles of luxury made at Paris. The report of M. Edouard Tailbuis, of Paris and St. Just, upon the production of French hosiery made on the occasion of the Great Exhibition in 1862, gives the following information, of which he enables us to avail ourselves. No one has been more prominent in employing effort and money to introduce English machinery into the hosiery manufacture of France than this gentleman; and he has added to them

modifications which adapt them for the production of articles specially suited to French demand. He has patented one of these in England in 1862, No. 1499, under the title of "a rectilinear knitting-frame." At St. Just, M. Tailbuis constructs hosiery machines of each class, worked by power; equal, probably, to any either in France or England. Of these, each capable of making eight fashioned hose or four drawers at once with great speed, he has upwards of thirty at work on his own premises, besides having constructed similar ones for others in France and Spain. M. Tailbuis is not only highly esteemed by his workpeople and neighbours as a public benefactor, but his services have obtained the marked approval of his sovereign, who has given him the Cross of the Legion of Honour.

"While England and France are the chief producers of hosiery, Saxony is known more particularly for the lower articles of bleached and unbleached cotton sold at advantageous prices to the consumers. They have machines equally good and cheaper labour, so that France cannot compete with her. England makes fancy articles which were once special to France on a large scale. The circular machine has been so improved by the English, as to reduce the cost of the production below competition. Their manufactures are on a colossal scale; their returns in 1862 being 160,000,000f. (£2,400,000). Their materials are of admirable regularity, and their bleaching and finishing excel in softness and brilliancy those of France, while these processes are cheaper by one-third. Their wages are it is true higher, but not so as to equalise the cost. Extra fine English hose are without rivals; but with the protection of the tariff and their excellent quality, French goods made stout and fully fashioned, will keep the home market.

The greater part of the French narrow machines continue inferior to the English. Some improvements have been introduced which have favourably effected the price of production, but much remains to be done. There is no country that may remain stationary or safely count on long acquired superiority in manufactures.

"The *rectilinear* machine with selvages and narrowings, has remained with some modifications as it was when first introduced into France, by John Hindret, in 1656. On these the narrowed and widened hosiery are chiefly made. The *straight rotary* appeared in 1844, and on this a few years after narrowed goods were made mechanically, and now are produced automatically. The *circular* machine appeared in France in 1827, and is now employed in nearly all the manufactories. The goods are shaped by scissors and sold at low prices. Some of these frames can make thirty ranges of loops every revolution. The use of the stitching frame lowers the cost of these goods, and is not sufficiently employed in our stocking trade.

"The production of hosiery has rapidly increased in France since 1855. It had become in 1860, seventy million francs, (£2,800,000)

and in 1866, ninety million francs, (3,600,000) of which, cotton was 55, woollen 35, silk 9, and linen 1 per cent. Troyes and Romilly had made great progress. At Falaise, Guibray, Rouen, Le Vigan, St. Jean du Gard, Moreuil and St. Just, *cotton* hosiery is made of good quality, but higher in price than English or Saxon. The French prefer their own Scotch thread hose of a transparent texture and made of bleached yarn, to the finest English hose which are, though of surpassing beauty, in little demand there as articles of luxury. In cotton hose of medium quality the English are unrivalled in price; as also in the qualities of all goods from the circular frame. Plain *woollen* hosiery of common kinds is made extensively in Picardy. Several thousand frames around Orleans make woollen goods. Circular woollen shirts &c., made in Picardy and at Paris, are consumed abroad as well as at home; woollen gloves, plain and ornamented, are produced of superior quality.

"Hosiery made of cotton mingled with animal wool, an important and varied branch in England, is still almost entirely ignored by French manufacturers. Yet this is destined to be the material for a large part of our goods. The price to be paid for this success will be found in our spinners placing the quality of their production on a level with that of England. Goods made from these yarns do not run up with washing, an attribute which ensures their use. The English mixed (merino) articles are of soft materials and agreeable colours.

"The silk hosiery of France is manufactured chiefly at Ganges St. Hyppolyte, le Vigan, St. Jean du Gard, Paris, and St. Just. *The production is lessened sensibly since England has entered on this manufacture, and disputes foreign markets with France.* Their hosiery silk goods are remarkable for their originality of patterns, harmonious combination of colours, and excellent fabrication. The quality of the silk articles from England and France seems in the main equal. The plain and open work embroidered white silk hose made in France are unrivalled in brilliancy and taste. They vary from 4 f. (3*s.* 3*d.*) to 120 f. (£4. 16*s.*) a pair. The French satin skin silk gloves made chiefly for exportation equally deserve praise.

"In 1865 France exported of cotton hosiery 4,152,164f. (£166,087); woollen, 7,175,379 f. (£287,015); silk and spun silk, 4,674,600 f. (£186,984)—total, 16,002,143 f. (£640,086). The same year she imported hosiery 600,288 f. (£24,015).

"In 1855 wages for making French hosiery were on narrow hand frames 1¼ f. to 2 f. (1*s.* to 1*s.* 7*d.*) a day, and on circulars 2¼ f. (1*s.* 10*d.*) a day. The women in the silk and spun silk departments gained 75 centimes to one franc (7*d.* to 9½*d.*) a day. The manufacturers stated that they must have a protective duty of 30 per cent."

The facts stated in this valuable report are in the main no doubt correct. The sentence italicised by us contains however an error. By a reference to p. 515, it will be seen that an hundred years ago there were many thousands of frames making English silk goods; but that during the last thirty years this trade has been threatened with extinction. Any diminution in French

exports of silk hosiery must arise from some other cause than successful English competition.

We have not any accurate knowledge of the number of machines, or amount of hosiery produced in other countries on the continent, besides Saxony and France. It has been stated, on doubtful authority, that there were, in 1835, 2000 frames employed in Italy. At Turin, where flowered silk hose were made in colours; and at Genoa, Mantua, Leghorn, Rome, and Palermo, where the ordinary kinds of silk hose and gloves were produced. Also that, at the same time, there were 7000 frames in Spain, spread over the districts round Barcelona, Chinchona, Madrid, Talavera de la Reyna, and Valencia, chiefly producing silk hose and gloves, for which articles Spain had been noted as the best in Europe for quality, though not for shape. Flowered silk hose in colours were said to be making at Valencia, having embroidered clocks put in by hand.

Although the hosiery exhibited from other countries in 1862, shewed nothing striking in kind or price, there were evident tokens of progress made since 1855.

CHAPTER XXXII.

CONCLUSION.

Demand for the long staple animal wool used for spinning worsted yarn, has been much increased from the great addition made to the power machinery now employed in the Leicester hosiery business. The production of shirts, drawers, and all other kinds of goods made upon rotary and round frames, is become surprisingly large: the quality and fashion being such as was until lately thought unattainable from steam machinery. The prices have been lowered and the consumption has been increased accordingly. The rate of wages to the workpeople has been advanced to an amount long unknown in the hosiery manufacture; while the cost of labour per dozen on power goods has been much reduced. The materials in the latter classes of goods now constitute from five-eighths to three-fourths of the entire cost of the articles. The colours of fancy hosiery goods should be of bright and fast dyes. In these respects they are much improved, and constant attention to this point is of essential importance. French practical chemistry enables their manufacturers to take a high position in regard to this process.

The far larger part of the cotton yarn used in the manufacture of English hosiery, and a considerable proportion of that consumed in Saxony, is spun at Stalybridge, Ashton-under-Lyne, and Bolton. The amount is become very much larger than it was twenty years since, in consequence of the wide and round frames, worked by power, introduced since that time. The consumption of materials in these classes of frames is enormous. Some of them require a supply of three hundred weight a week. The mills for spinning hosiery yarn in these districts have increased greatly in number

and power of production. Bourbon and Mauritius wools deserve from their colour greater use here. Since the cotton famine, the spinners have not confined themselves as formerly to the use of South American wool; but have been consuming a large amount of the best East India kinds, for spinning which into hosiery yarn a good deal of the machinery has been adapted. Should the quality of the wool used for hosiery received from thence remain inferior to South American, it might in time prove very injurious to the interests of the trade, by deteriorating the quality and wear of the articles made from it. The custom-house registered value of exports of cotton hosiery in 1864, £461,046, had become in 1866, £793,705. The imports in 1864 of cotton hose were 606,566 dozens, and in 1866, 971,247 dozens. The registered value of lace exported in 1864 was £367,239; in 1866, £547,657. This increase in the export of hosiery and lace was exceptional, and due to the cessation of the American civil war, with an expectation of an increased tariff there.

Forty years ago the machinery of the bobbin net trade was to a large extent in the hands of more than a thousand small owners, chiefly handicraftsmen, most of whom were unused to business, and of course practically unacquainted with the principles on which it should be conducted. These employed some hundreds of agents in the disposal of the produce of their machines. Many of these were not much in advance of their employers; they carried their goods in large packs daily for sale at the warehouses, and in the main were paid weekly. This plan had its disadvantages both to maker and buyer; so with the disappearance of the small owners it has for the most part passed away. The owners of most of the fancy machines now finish and sell their own goods; the sale of the remainder and of plain nets is in few hands. The trade seems to be approaching a further important concentration in the ownership and employment of machines; unless, indeed, as is prognosticated by some, they should be largely exported abroad. The financial crisis through which the nation is passing has materially injured this branch of business and caused much loss. In the last three months of the year 1866

more than half the plain and fancy machines were standing; the remainder were at work during such restricted hours as reduced the production to one-third its usual amount. There are it is thought symptoms of improvement in the demand for Nottingham lace. If realized, it may be hoped they will not be followed by the hitherto usual speculative construction of wide and speedy machinery. After the rapid decline experienced during several past years, the advent of that better state of things so ardently desired will be hailed with much satisfaction.

The early mode of supplying the retail demand for bobbin net in the metropolis and in the larger cities and towns in the country, was at first based upon the practice of the Buckinghamshire hand lace manufacturers, who waited upon the London trade taking the goods they wished to dispose of with them in assorted boxes, and then and there effected the transactions without further delay. For years after bobbin net was introduced packages were similarly made up, two of which being slung over a porter's shoulders, who accompanied the town traveller, their contents were offered to buyers throughout the appointed district. At length the quantity and weight increased so much that horses and vehicles laden with stock were substituted in London by the principal houses. The like mode was adopted for the country journeys by Messrs. Fishers and Co., Messrs. Copestake and Co., and others. Each of the houses just named might have during that period thirty to forty such vehicles, transporting as many tons weight of lace goods for the daily service of town and country customers. Railways and other means of saving time and facilitating business have rendered these laborious and expensive processes for the most part unnecessary. For instance, the house of Copestake and Co. transact now so much of their immense operations in Cheapside, as to require the attention of two hundred or more countermen, twenty-five managers of departments, and ninety clerks. Their country and foreign trade employs thirty agents, and is carried on at seventeen centres, as Nottingham, Glasgow, Manchester, Paris, New York, Philadelphia, and elsewhere. The returns are of an

almost incredible amount, and is an instance of extraordinary success; it is cited here because founded (about 1826) primarily in connection with the lace trade. The partners are highly esteemed as men of business, and Mr. Moore is well known for his ardent devotion to the interests of various benevolent institutions with which the metropolis abounds.

The plates representing lace in this volume, furnish an example of one mode of facilitating the sale of light tissues. Instead of pattern books containing bits of the designs cut off and fixed, one of which books was furnished with prices and numbers to each customer, Mr. William Taylor, a stationer at Nottingham, about 1844, devised the plan of taking re-impressions on paper, of impressions obtained on a suitable material from the pattern itself. Such were produced by him in that year; shewn in the exhibition of 1851; and have been ever since used in the lace and muslin trades, as also for producing illustrations by this so called "nature printing." Of the accuracy and delicacy of such impressions, our readers will judge. We embrace the opportunity of claiming for Mr. Taylor the credit which is his due for so important a discovery, as to which, others have hitherto received almost the entire praise.

While the population of Nottingham and Leicester, has advanced equally with the manufactures carried on in those towns, there has been a marked extension and improvement of the buildings used for trade purposes in each place; lace and hosiery warehouses now cover fourfold the area of ground thus occupied a quarter of a century ago, and many of them are of noble architectural proportions. In these, over-crowding may be avoided and sufficient ventilation secured. Factories also are now constructed in a superior manner and correspond more and more in their management with the spirit of the legislative enactments affecting them. The health and morals of those engaged in warehouses, in which the female sex so greatly predominates, are subjects of increasing attention on the part of employers. The establishment of Messrs. Thomas Adams and Co. in Nottingham, and those of Messrs. Copestake, Moore, Crampton, and Co. in

London and Nottingham, are not only well known for the magnitude of their transactions, but for an arrangement which gives evidence of special solicitude on these points. From four hundred to six hundred persons are employed in each of these warehouses; and for their instruction and guidance in religious duties, a clergyman conducts in a room set apart for the purpose, a short and interesting service, before entering upon the secular duties of the day. These devotional exercises, to which are added visits of sympathy and comfort by the minister to those who may be sick or otherwise afflicted, have proved both useful and acceptable. Other houses are using various means having the same end in view. These are steps in the right direction; tending as they do to identify more closely and plainly the true interests of the employers and employed. The practicability and permanence of these plans were for a time doubted. In this age of excessive competition, to exemplify the undeviating consistency and high Christian principle necessary on the part of those who institute them, must be attended with corresponding difficulties, yet the excellency of the design and its success thus far, calls for this record of a very praiseworthy effort.

The important advance which has taken place in the frame-work-knitters' wages has enabled them to obtain larger supplies of wholesome food than was possible for many years. Their physical appearance is proportionably improved, and they are far better clothed. So that instead of being as formerly, easily distinguished from other workmen by their anxious countenances and slender limbs, they are now generally well favoured, stout, and of respectable appearance. There has been a large addition made to the former scanty furniture of their dwellings. When however excessive and long continued depression has once lowered the feeling of responsibility and self-respect by withholding the means necessary to sustain them, it may require more than one generation to pass away before this wholesome influence shall be re-established. This is especially the case in regard to the self-denial of parents necessary to secure for their children a sufficient education.

The larger proportion of the children of parents employed in both hosiery and lace are growing up, from this and various other causes, without a sound practical training in knowledge and habits. There is no real or unavoidable reason why this should be the case, and it ought therefore to be remedied. Suitable training cannot be long withheld except to the degradation and loss of the young, dishonour to their parents, and danger to society. We submit that the education of the children of working men, as well as of all others, should include in addition to elementary science, information more or less extended upon household economy—the mutual duties of parents and children—husbands and wives—masters and servants—governments and their subjects: also on wages, profits, savings, and their reciprocal influence—combinations and strikes—utility of machinery—capital and labour—alternate prosperity and depression incident to manufactures, agriculture, and commerce—relation between population and subsistence—scarcity or redundancy of labour and its price—over-production, over-trading, and speculation.

All doubt as to whether such a course of instruction is within the power and means of the community in these midland districts (and probably in any other) is removed by the current rates of wages of English artizan labour and by such facts as are given at page 521, of the extent and cost of Saxon schools. In these, we are assured, every topic of inquiry above indicated is efficiently treated at some period or other of the six years, while moral principles are explained and enforced during the whole course. The effect upon the face of society is easily discernible. The English as well as the Saxon hosiery business has been limited, during the past year, not by want of demand, but of hands. This will, if continued as we hope, secure ample wages and profits. It will be a noble result, should employers and employed in this country combine to improve these advantages, by taking the best measures for imparting an excellent education to those that now depend upon them for it—whether it should be national and compulsory, denominational, or individual, it is not necessary to attempt here to decide.

A remark, shewing the need of caution, is suggested by the extraordinary advance in the Saxon and, it would seem, still more rapid increase in the United States hosiery trades, and in the present amount and position of the French lace business. It is certain that we possess exclusively no one important element of manufacturing prosperity. The working classes in these, as in most other English trades, are now freed from misery and wrong, so far as wages are in question, and ought wisely and carefully to observe the signs of the times abroad. Capital in manufactures and trade may be more easily transferred than ever before, to avoid excessively advanced rates of wages; or vexatious interference with the management of business; or such high prices of commodities as must eventually reduce consumption, and so, in due time, seriously limit the amount of employment.

The principle of 'limited liability' has been introduced into the businesses of hosiery and lace. The firm of Thomas Adams and Co. in lace, Hine, Mundella and Co. in lace and hosiery, both of Nottingham; Noon and Co., hosiers at Leicester; and Morrison, Dillon, and Co., the very extensive dealers in hosiery, lace, silks, and haberdashery in London, with some others, have made this change. There has not been any co-operative manufactory established, we believe, in the staple trades of the midland district. Lace being an article immediately subject to the caprices of fashion, would probably be too dangerous, and the extent over which hosiery machinery is spread too difficult, to be made the subjects of co-operative management by the hands employed in these trades. Stores for the supply of food and clothing are established by them in increasing numbers.

A considerable part of the manufacture of hosiery from hand frames is still carried on through the intermediate agency of those who receive materials from hosiers, distribute them to the master workmen, then collect and return the goods when made. But there is now full knowledge amongst all the parties, the journeymen included, that upon the work being properly done, the workmen must be dealt with fairly in price and charges; or the ultimate employer would not obtain his supply of wrought goods.

This is gradually bringing about more satisfactory relations the one with the other. Fewer women labour in the stocking frame than formerly; and the number of apprentices taken is less every year. There is danger of embarking too large a portion of available capital hastily, in the swift and effective machinery now within reach of the manufacturer. The temptation to this is great; but if the requisite caution be employed, there seems every reason to anticipate the further profitable extension of this business, by supplying the legitimate demand for both home and export consumption of hosiery.

A report on the rates of wages now paid in a considerable number of trades, including those current in the hosiery and lace manufactures, has just issued from the Board of Trade. To the statement from Leicester at p. 8, there is appended the following note upon narrow hosiery frames: "These are old-fashioned frames now but little used; being superseded in great measure by the wider frames. More employment would be found for these machines, but hands cannot be obtained; better paid labour being more plentiful." The rates of wages are no doubt correctly estimated; the difficulty as to finding hands to work *all* the narrow machines exists, and may probably increase with the greater use of wide and round power machinery. And narrow hand frames may be much less used in "Leicester and its neighbourhood," where it is possible to gather them into factories, than formerly. In 1833, Mr. Biggs found 11,500 narrows were at work in the whole county; and in 1844 there were upwards of 15,000; we would therefore suggest that (without actual enumeration, which we understand has not taken place) it may be reasonably doubted, whether this great body of frames is now really but little used and is largely superseded. It is believed by persons possessing considerable knowledge on this subject, that the reduction in the number of narrow frames actually employed in Leicestershire, is not greater in proportion to the entire number, than in Nottinghamshire. If so, there would remain 10,000 or 11,000 at work. Besides such a serious change supervening in the employment of the labouring

population of the county of Leicester as this note seems to indicate, could not take place without unmistakeable signs in the stocking making localities spread over two-thirds of its surface. Of these there is no sufficient evidence, either in the number of newly constructed power frames, or the removal and absorption into factories of the labour previously employed in the narrow hand ones.

This is one of the cases seeming to justify the remarks offered at p. 453, upon the importance to the real interest of all parties engaged in making and selling goods, of statistics, collected and published by competent authority. The error, if it be one, just pointed out, is no doubt an involuntary one, but may mislead in future, if not rectified.

With foreign manufacturers of hosiery and lace we trust our rivalry will be always carried on in an amicable spirit. It may, without doubt, be made mutually advantageous. For we have been from time to time indebted to them, as they have often been to us, for improvements in machinery, and still more in the arts—the result of well applied ingenuity and skill. The diversity of wants arising from an ever increasing civilization and refinement, and consequent expansion of the markets of the world, may be reasonably expected to give profitable employment to the talents and energies of skilled workmen, as well as to the capital and mercantile knowledge of employers in all manufacturing countries. Higher wages will reward the labour of the one, and an increase of income and capital resulting from the responsible exercise of sound judgment the other. These will have the effect, if anything can produce so happy a result, of uprooting national trade jealousies, and rendering strifes between employers and employed infrequent if not impossible.

FINIS.

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