

The
ART OF WEAVING
BY HAND AND BY POWER

WITH AN
INTRODUCTORY ACCOUNT
OF ITS RISE AND PROGRESS IN
ANCIENT AND MODERN TIMES.
FOR THE USE OF
MANUFACTURERS AND OTHERS,

BY CLINTON G. GILROY

PRACTICAL WEAVER AND MANUFACTURER.

GENERAL SUBJECTS OF THIS WORK.

- | | |
|--|---|
| 1. Plain Weaving. | 5. Figured Weaving |
| 2. Tweeling | 6. Carpeting: including ingrain, Imperial,
Brussels, Wilton Turkey and Velvet
Pile; also Rugs, Tapestry, etc. |
| 3. Double Cloth, (plain and tweeled)
Marseilles Guilting and Velvets. | 7. Lace and Embroidery |
| 4. Cross Weaving, comprising Gauze
and Net Work. | 8. Plain and Figured Weaving by Power. |

ILLUSTRATED BY APPROPRIATE ENGRAVINGS.
IN ONE VOLUME.

NEW YORK:
GEORGE D. BALDWIN, 35 SPRUCE STREET

1844

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Entered according to act of Congress, in the year 1844, by
GEORGE D. BALDWIN,
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STEREOTYPED BY T. B. SMITH,
216 WILLIAM STREET, NEW YORK.

ADVERTISEMENT.

In making books *we* own that we are '*green*,'
And for *defects* this should be some apology.
The Author of this Treatise has not been
Plucking sufficient fruit from off the knowledge tree ;
A fact which by our readers will be seen,
Without the proofs afforded by phrenology ;
But, to avoid the evils of satiety,
We shall endeavour to give some variety.

Materials inexhaustible abound,
Which, if well handled, might adorn our pages ;
By learning, metaphysical, profound,
We might, no doubt, be rank'd among the sages ;
The *natives* too, perhaps, we might astound,
With lists comparative of weavers' wages ;
Or, essays on *political economy* ;
Or, loftier still, the science of astronomy.

Though all these themes are worthy of attention,
We think it proper in this place to state,
That to exclude all chances of dissension,
The Author shall not in this Work relate
A sentence, which, by men of *comprehension*,
Could e'er be deem'd admitting of debate :
Hence, *politics* we never once shall touch,
Lest we should say too little, or too much.

'Tis wisdom to make hay while weather's sunny ;
But, here we should not be misunderstood :
We disavow all thoughts of making money :
We publish *solely* for the *public good*,
(Our own included). Op'ning flowers yield honey ;
This Book shall yield to weavers ample food ;
Food for the mind, which, when *digested*, may
Yield food to fill the body every day.

The present Work is not a periodical ;
We do not publish number after number
Poetic, philosophical, rhapsodical,
With shining gems amidst a mass of lumber.
Our plan, in most respects, is quite methodical.
Meantime, our readers we shall not encumber
With more remarks, but show them, with facility,
A specimen or two of our ability.

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INTRODUCTION.

A THOROUGH knowledge of the Art of Weaving, in all its varieties, is the gradual result of indefatigable exertion, and cannot be acquired, except by a *long* course of practical application in those parts of the world where it is best understood.

Many of our American weavers already possess sufficient skill and dexterity in several branches of this, the most complex of all arts, to prove dangerous rivals to those similarly engaged in other parts of the globe; but the field for improvement is still very extensive. In every quarter of this vast country men of scientific genius are busy in applying those elementary and *speculative* principles, which were formerly confined to the closet of the philosopher, to the grand purpose of social improvement. The great chain which connects theory with the useful arts, is rapidly extending, and it is impossible to anticipate what may be the result.

The fabrication of almost every species of cloth appears to have been carried on to a surprising extent in the ancient world; and a knowledge of the processes by which it was accomplished, together with the improvements made on many of them since their introduction into Europe, are objects of the first national importance, and no apology is necessary for our attempting a collection of facts on the subject, embodying them with our own experience as a practical weaver and manufacturer, in England, Ireland, Scotland, France, Belgium, Prussia, &c., for nearly a quarter of a century.

Although the art of weaving the more common fabrics is extensively known in this country, nevertheless, the intricate and ornamental textures are not *well* understood; neither have they been explained by any one thoroughly versed in the business; which precludes the necessity of further observation from us on this head.

A variety of publications relative to this branch of industry, designed for the use of weavers of common fabrics, have, indeed, appeared, at different times, by such authors as O'Doherty, Diogenes,

INTRODUCTION.

Murphy, Greenough, Peddie, O'Westman, Yates and Ure; but, that these writers were wholly, or in a great measure, ignorant of the subject, we have demonstrative proofs in their own works. The books of these men contain merely such scraps and sketches as were furnished for them, by persons who required instruction themselves, as the matter there presented, abundantly testifies. Such compilations are nearly filled with tables and useless repetitions, "*for the purpose of facilitating calculation,*" as they are termed. These tables appear rather to have been intended for the use of the plain cloth manufacturer of the twelfth century, than for the fancy warper, or figure weaver of our own day. To the mechanical part of the business, such as the construction of the looms and other apparatus requisite for the production of the more intricate kinds of textures, *and the necessary practical instructions*, they have scarcely alluded in their treatises. They only speak of the art in its imperfect state, as it existed in England, Ireland, and Scotland in times long past; and hence such books are not calculated for the present age of improvement. Indeed, it seems to us, that these authors were, (in the words of Pollok)

"Resolved (*in spite of fate*) before they died,
To make some grand discovery, by which
They should be known to all posterity."

The great majority of mankind are ever prone to limit their desire of information, to that which seems at the time most necessary to their *subsistence*. The weaver who is accustomed to be employed at one kind of work, seldom troubles himself to enquire by what means other kinds are now, or were produced; and although by this constant application to one branch, he increases his practical dexterity in it; yet, such a course, at the same time, tends to impede his progress in the attainment of a complete knowledge of his vocation. Indeed, many of the different species of weaving have already become nearly local. In Great Britain, for example, the Manchester weaver is, in general, as ignorant of the mode of mounting a gauze spider net, as he of Paisley or Glasgow, is of a Pekin brocade, or an Egyptian *shebetz*. The division of labour, however, is carried still further: the mounting of a loom in the figured department is frequently the business of several persons, and the working of it that of from one to six others. Some figured looms have as many as eight Jacquards, of 400, 600, 900, and even 1300 needles each; and from one to four pulley-boxes, each of which has a tail, simple, and drawboy to operate upon it. These complicated looms contain from one to twelve cumber boards (some-

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times called *harness boards*) which are often made stationary; but at other times one, or more are elevated or depressed, at every 2d, 3d, 4th, or 6th, passage of the shuttle. In weaving Marscilles quilting and petticoat robes, on this plan, only two shifting harness boards in connection with two, or more leaves of headles, are used. But these subjects will be more fully treated of in another place.

The study of the art of weaving will at least afford to an inquisitive mind, a source of rational and innocent amusement. Besides this consideration, many circumstances concur, to render records of the state of every art, peculiarly desirable. It is well ascertained by the researches of antiquarians and hierologists, that many useful branches of art, which were known and practised by the ancients, have been almost entirely lost, for want of such records. Perhaps two-thirds, or more of them have thus sunk into oblivion; take for example, that of weaving *six* and *seven* ply carpeting, (known to the ancients under the cognomen of *Tymolus matting*),* by the power of compressed air.

* The eminent German hierologist, Dr. Lepsius, now employed in Egypt by the Prussian government, in a recent letter, after mentioning the many discoveries he had made of ancient ruins, tombs, &c., writes as follows:

“With the exception of about twelve, which belong to a later period, all these tombs were erected contemporaneously with, or soon after, the building of the great pyramid, and consequently their dates throw an invaluable light on the study of human civilization in the most remote period of antiquity.—The *sculptures* in relief are surprisingly numerous, and represent whole figures, some the size of life, and others of various dimensions. The *paintings* are on back grounds of the finest chalk. They are numerous and beautiful beyond conception—as *fresh and perfect as if finished yesterday!* The pictures and sculptures on the walls of the tombs represent, for the most part, scenes in the lives of the deceased persons, whose wealth in cattle, fish boats, servants, &c., is ostentatiously displayed before the eye of the spectator. All this gives an insight into the details of private life among the ancient Egyptians. By the help of these inscriptions I think I could, without difficulty, make a Court Calendar of the reign of King Cheops. *But, my friends, let no monument give you or me hopes, since not a pinch of dust is left unturned, by us, of the mortal remains of old King Cheops!* In some instances I have traced the graves of father, son, grandson, and even great grandson—all that now remains of the distinguished families, which five thousand years ago, formed the nobility of the land. I now employ daily fifty or sixty men, in digging and other kinds of labour, and a large excavation has been made in front of the great Sphynx.”

Another writer has condensed from Rosellini, and other hierologists, the following remarks:

“Philologists, astronomers, chemists, painters, architects, physicians, must return to Egypt to learn the origin of language and writing—of the calendar

The ornamental arts are so much regulated by the prevailing fashion, and caprice of mankind, that many species of fancy manufactures lie neglected for years, and, in many instances, they could

and solar motion—of the art of cutting granite with a copper chisel, and of giving elasticity to a copper sword—of making glass with the variegated hues of the rainbow—of moving single blocks of polished syenite, *nine hundred tons in weight*, for any distance by land and water—of building arches round, and pointed with masonic precision, unsurpassed at the present day, and antecedent, by two thousand years before the Dorians are known in history—of fresco painting in imperishable colours—and of practical knowledge of anatomy.

“Every craftsman can behold, in Egyptian monuments, the progress of his art four thousand years ago; and whether it be a wheel-wright building a chariot; a leather cutter using the self same form of knife of old as is considered the best form now; the plain, and fancy weavers actively employed at their respective looms; a white smith using that identical form of blow pipe, but lately recognized to be the most efficient; the seal engraver cutting in hieroglyphics such names as *Shoofu's, Arphaxad's, and Arkite Ghiden Ghelen's*, above four thousand three hundred years ago; or even the poulterer removing the pip from geese; all these and many more evidences of Egyptian priority now require but a glance at the plates of Rosellini.”

To this catalogue of Egyptian arts, a long addition might be made of monuments descriptive of the goldsmith's and jeweller's work; instrumental music, singing, dancing, and gymnastic exercises, including children's games, like some of the present day; the tasteful furniture of their houses; ship building; drawings in natural history, so true to life, that the French naturalists, by means of them, instantly recognized the several species of Egyptian birds designated by them; and of numberless other branches of art.

In Persia also, much ethnographic information has lately been brought to light, by the architects and artists attached to the French embassy in that country. Their operations embrace ruins of the ancient cities of Nineveh, Babylon, Ecbatana, Persepolis, Ctesiphon, &c. These researches in connection with the labours of Groteford and Lassen, who have deciphered the arrow-headed inscriptions of those cities, are of great importance in elucidating a portion of the world's history, of which we know so little. The French government has lately sent a party to explore the regions between Cashmere and Kafferistan, with orders to report on the Geography of those countries—the various native tribes by which they are occupied, their languages, monuments, &c.

In Asia Minor a new field for antiquarian researches has been opened, which bids fair to throw much light on the history of several nations, and particularly the Greeks, at a period, the history of which we know but little. The researches of the English have chiefly been in ancient Lycia, where in two different expeditions, Mr. Fellows has made some important discoveries of cities, remains of temples, inscriptions, &c. He has also been able to make out the language of the people who erected these edifices, through bilingual inscriptions found there. He is now on his way there again, with a large company and a steamer, for the purpose of transporting to England such

never again be introduced, unless a knowledge of the processes employed in their production were preserved. When such knowledge is only transmitted verbally, and when it is confined to operative

monuments of art as are valuable and in good preservation. The French and Prussian governments have scientific expeditions besides, in other parts of Asia Minor.

In Abyssinia are travellers from England, France, and Germany, who are engaged in scientific explorations of the country. Their labours will contribute greatly to our knowledge of that hitherto unknown region. On the site of ancient Carthage and in the country adjacent, some interesting discoveries have been made. Among these the following articles have been found:

1st. A complete power loom of *bronze*, of vertical construction, adapted to weave *sixteen* webs of cloth at one and the same operation, either plain, tweeled, or figured, and with from one to thirty-seven shuttles, &c.

2d. A loom for weaving dimity and such stuffs, with tappet wheel to work the treadles, and a curious motion to stop the machine when the weft thread or threads break. This last contrivance consists of two parts, one of which is very like an 'Irish gridiron,' and is fixed in the lay in a vertical position, about three-fourths of an inch from one end of the reed; the other part resembles a French four-pronged eating fork, and is made to play into the former at each, and every throw of the shuttle. But as this motion (with several other valuable contrivances in weaving) was patented by us in England, France, and other countries in the years 1833, 34 and 39, *the claims of the said hierologists to the contrary thereof notwithstanding*, no farther notice need be taken of it here; and particularly so, as it is now being adapted to common power looms at Paterson, N. J., Troy, N. Y., and at Lowell, Mass., where the curious may see it in full operation, and be better able to judge of its merits for themselves.

3d. A spinning machine with two hundred and fifty-six spindles, copper drums, and India rubber bands to drive it; all of which are in a tolerable state of preservation; the whole bearing a very close resemblance to the 'Danforth frame.'

4th. 18½ yards of 'net work' or lace, figured, similar to that used in the decoration of Solomon's Temple, and of which so frequent mention is made in the book of Exodus. This specimen corresponds in many respects to that shown us by his Holiness, the Pope's antiquarian when at Rome, in April, 1831, and of which we shall have occasion to make further mention hereafter.

5th. 13½ yards of beautiful lace, being composed of gold and silver threads alternately, on which are represented the sun, moon, and stars; the crocodile, pelican, heron, and goose; and also a man and woman in a state of nudity, eating fruit, which they appear to have plucked from off a tree hard by; there is also in the same group a likeness of a serpent, very much resembling our modern boa constrictor.

6th. A penknife with 98 blades; but this does not so much excite our wonder as the others, because we are well aware of the fact, that immense manufactures of penknives were carried on in ancient Babylon, and other cities of the land of Shinar, long before the Jewish dispensation; see also the 36th chap. of Jeremiah and 23d verse.

tradesmen, employed in the active duties of their vocations, little expectation can be formed of its general diffusion. The attention of such men is naturally more directed to their present, than to their former employments; and when it is no longer in their power to illustrate the instructions which they may, occasionally, wish to convey to others, by showing them the practical operation, the task becomes doubly difficult. From the want of proper information on such subjects a person may possibly think himself the inventor of a certain machine, which he conceives to be legitimately begotten, and may succeed in obtaining, from capitalists, unskilled in the particular art to which it relates, vast sums of money, on the strength of such an impression; and still a similar machine may have been in use long before, or even is at the present day, without his knowledge of the fact. Many a man has been deceived in supposing himself the originator of a certain contrivance, which he might have found described in some old book, or Irishman's portfolio.

It ought to be our study to fix permanently upon the memory, some of the extraordinary events that happened in the world thousands of years before we had an existence upon it. We find ourselves inhabitants of one of the numberless planets which are ever rolling along through infinite space, at a most astonishing rate of speed. We have no means of knowing at present what beings inhabit, or what laws govern those glorious orbs that on all sides surround us, or how far advanced in the arts their inhabitants may have become, and particularly in that of power loom weaving with *mesmeric cams*. We have now no communication with other worlds, nor with the beings that people them. This earth on which we live is ours (that's a fact) and it affords ample scope for human study. The enquiring mind should be anxious to know, who were the best manufacturers of *figured* and other fabrics that from time to time flourished on its variegated surface; what events, changes, and revolutions it has undergone, and how many Jacquard looms, and other useful machines, invented by our antediluvian relations, have been engulfed in its bowels, or otherwise knocked into chaos. It is only by reading, by searching the records of the past, by deep

We confess that we, ourself, are surprised, that a complete power loom of such astounding capacity (including one of our own patent motions) as that just mentioned, together with a 'Danforth frame,' should be dug up in this way. Such is to us a — mystery! We will *henceforth* place implicit confidence in the words of the wise man, as recorded in the 1st chapter of *Ecclesiastes*.

mental application, and above all, by bodily exertion, that we can arrive at this profound knowledge; but, if we can, although only partially obtain some accounts of the arts, and of what has happened connected with them, in ages far remote, it is our duty not to keep them locked up for our own gratification, but to bring them forth for the improvement of our fellow-men, and more particularly for the manufacturing portion of our own community.

We are confident that many, and were about to say, the generality, of readers lose more than half the advantage they might otherwise derive, for want of fixing on their minds the *dates* and *periods* of time most remarkable in the history of such subjects as the present.

"To him who reads with judging eyes,
And studies as he should,
Philosophy brings large supplies;
His mind improves, his pleasures rise,
He cannot but be great and wise."

The traveller who visits different countries to view their varied scenery, and, *perhaps*, to pick up the inventions of ingenious men by the way, would experience but little advantage if, when he entered into a zephyr three ply bed quilt manufactory he stood still, and kept his eye fixed on one object only, for example, such as a double or treble shifting cumber board; but when he looks around him, views the electric cams, the mercurial shuttle changers, the revolving detached shuttle boxes, with Poole and Fletcher's patent galvanizers, hollow-cone warp dividers, &c., as they perform their respective functions, both separately and collectively; his eye glistens with gladness and his heart beats with delight, while he sees that he may handily turn the ingenuity of other men to his own purposes, without even thanking them for it. If our traveller should chance to be one of those prodigies of nature, to whom fate has given some lucky powers of combination and adaptation, he at one view can see the mechanism in all its various phases of operation, and he enjoys the scene with exquisite relish.

"Unto the solid beam the warp is tied,
While hollow cones the parting threads divide,
Through which a thousand shuttles swiftly play,
And for the zephyr weft prepare a ready way."

(Metam. VI. O'Rourke's Trans.)

We shall here notice two objections which have been urged by several European manufacturers against us, in our undertaking to publish the present work.

The first of these is, that it is improper to divulge the secrets of any trade, because it may operate to the prejudice of those who practise it. This doctrine is now so justly, and almost universally exploded, that we shall occupy very little room upon it. It will be seen at once, without entering at all into the question of the policy of monopolies, whether preserved by secret or legal restrictions, that the case does not apply to the business of weaving. It is absurd to suppose that a trade which employs so many millions of people, and which has existed almost since the creation of the world, either is, or can be secret. Besides, experience has sufficiently proved, that liberal and unreserved communication between artificers of all descriptions, has always produced good and never evil. Indeed, it is obvious that every man, where this takes place, receives the advantage of the instruction of many, and gives only his own in return. The balance, therefore, must always be in his favour. With these short remarks we shall dismiss this objection.

The second objection, though it does not appear to us to stand upon a more solid foundation than the other, may require a little more consideration. The objection is, that by communicating information upon the art of weaving, a knowledge of that art may be acquired in other countries, consequently the manufactures may become less productive to those engaged in them.

Although this proposition were admitted in its fullest extent respecting arts in general, it could have no effect on that of weaving, which has been entirely imported from the East, into Europe, and has received but little improvement in that quarter of the globe.

The great antiquity of this art, necessarily involves the earlier ages of its history in considerable obscurity. It is very evident, however, that none of its branches originated in Europe, or America, the cotton stuffs worn by the aborigines of this country, when discovered by Columbus excepted. According to Melik Cassam Mirza of Tebriz, Persia, the silk manufacture was first practised in China, by Ouang Tippo Ichao,* a native of Tsing Kiang Fou, in the province of Kiang Nau, about the year of the world 1743; and from other sources equally authentic, we learn that the cotton had its origin in India, and the shawl and carpet in Persia.

* This is undoubtedly the same individual, as appears from the name, to whom Chinese historians give credit for having invented the most powerful of all ancient machines, "the gods' eyes puncher." This machine was of such tremendous pressure as actually to force, with a single clip, a hole of 8½ inches

These facts sufficiently prove that we have no pretensions to superior knowledge, or exclusive possession of any secrets or mysteries connected with the art of weaving. The very names of many fabrics correspond to the places where they were first manufactured, and the following, for example, are all eastern: Nankeens, Ballasores, Madrasses, Bengals, Lachores, Bungoes, Trebizonds, (a kind of frizzled net) Bagdad lace, Cashmere scarfs, Japan brocades, Pekin brocades, Canton crapes, Turkey gauze, Grecian net, Damask, &c. All these, and many more, including dimity and muslin, are fabrics of eastern manufacture.

Cotton stuffs, properly so called, are first mentioned as an article of commerce in Arrian's Periplus of the Erythrean sea. He informs us that they were imported from India to Aduli, a port on the Red Sea, and he specifies as the principal marts of Hindoostan, where the goods were obtained, Barygaza, *Baroche*, Masalia, and *Masuliputam*, which was then as it ever since has been, famous for the manufacture of cotton goods. He adds that "the transparent gangetic Sindones" were the most highly valued; and this superiority of the Bengal muslins continues to the present day. We may remark that the Periplus affords an extraordinary proof of the condition of the arts in India, for the description which Forbes gives of the manufactures of Baroche is very nearly identical with that furnished by Arrian sixteen centuries ago. "The cotton trade at Baroche," he says, "is very considerable, and the manufacture of this valuable plant, from the finest muslin to the coarsest sail-cloth, employs thousands of men, women, and children, in the metropolis and adjacent villages. The cotton clearers and spinners, generally reside in the suburbs or poorahs, of Baroche, which are very extensive. The weavers' houses, are mostly near the shade of tamarind and mango trees, under which, at sunrise, they fix their looms, and weave a variety of cotton cloth, with very fine baftas

in diameter through a wrought iron plate 1½ inches thick. It appears that the eyeballs of these idols, were generally made of cast iron, 'polished and furnished,' and adapted to fit the sockets with the greatest precision. A small hole about the size of a cent, was usually gouged out in the front and centre part of the eyeball, to form the pupil. Into this hole a black stone, or some other substance of the same colour was inserted, and thus his godship was enabled at a glance to penetrate to the hearts of his worshippers. Every nine gods had a 'greaser,' whose business it was to cleanse off the rust (*which accumulated in damp weather*) from the optics of each god; and this operation was always performed on the fifth day of the new moon each month throughout the year—leap year excepted.

and muslins. Surat is more famous for its coloured chintzes and piece goods. The Baroche muslins are inferior to those of Bengal and Madras, nor do the painted chintzes of Guzerat, equal those of the Coromandel coast." (Forbes, *Oriental Memoirs*, vol. ii. p. 222.)

We can find no trace of cotton goods imported into Europe before the Fall of the Western Empire; but they began to be introduced into Constantinople about the sixth century, for they are mentioned in the tariff of import duties issued by the emperor Justinian. In Arabia however, cottons and muslins had come into common use about the time of Mohammed, for they are frequently mentioned in the history of the early khaliphs. The first "muslins" so called from their being woven at El Mosél in Mesopotamia—like the English "cambrics," were not composed of cotton, at least not exclusively, for the muslins mentioned by Marco Polo are expressively stated to have been woven of "gold and silk." The conquests of the Saracens and their successors, the Turks, extended the use of cottons over a great part of Europe, Asia, and Africa.

It is a fact (not generally known) that Columbus found the aborigines of America clothed in cotton fabrics.* It was long believed by the learned that the ancient Egyptians were acquainted with the manufacture of cotton; and that the "white works," mentioned by the prophet Isaiah, were composed of this material. Herodotus, in the fifth century before Christ, distinctly asserts that the Indians wore cotton; "They possess likewise," says the same historian, "a kind of plant, which instead of fruit, produces wool, of a finer and better quality than that of sheep; and of this material the Indians manufacture their clothing." Nearchus, the admiral to whom Alexander entrusted the survey of the Indus, mentions both the plain cottons, and the figured chintzes of the Indians, and the geographer Strabo, who was cotemporary with the Christian era, records, that in his day, cotton plants were grown, and cotton cloth manufactured, in Susiana, a province at the head of the Persian gulf. Pliny, who lived rather more than half a century after Strabo, is the first writer who mentions the growth of the cotton plant in Egypt; "The upper part of Egypt," he says, "verging towards Arabia, produces a shrub which some persons call *gossypium*, but a greater number *Xylon*, and from this the textile fabrics called *Xylina* are manufactured. It is small and bears a fruit somewhat like a filbert; a downy wool found in the interior is

* See Irving's *Life of Columbus*, (abridged edition,) pages 63—173, and 219.

spun into thread ; there are no fabrics to be preferred to these for whiteness or softness ; the garments made of this material are far the most acceptable to the Egyptian priests." The same naturalist, mentions the "wool bearing trees" of the island of Tylus in the Persian gulf, and says that they bear a fruit like a gourd, and of the size of a quince (*cotonei mali*.)

"In India," says a learned writer, "women of all castes prepare the cotton thread for the weaver, spinning the thread on a piece of wire, or a very thin rod of polished iron with a ball of clay at one end ; this they turn round with the left hand, and supply the cotton with the right, (like the ancient inhabitants of Nodville ;) the thread is then wound upon a stick or pole, and sold to the merchants or weavers ; for the coarser thread the women make use of a wheel very similar to that of the English spinster, though upon a smaller construction. The mother of a family, in some instances, will procure as much as from \$1,75 to \$2,25, a month, by spinning cotton. The tannies or weavers are in six divisions, which have no intercourse with each other, so as to visit or intermarry. They lay the frame of their loom on the ground, and sit with their feet hanging down in a hole cut in the earth.

"The coarse cloths worn by the natives are made in almost every village. At the Dhaku factory some years ago, cloths to the value of 80 lacks of rupees were bought by the East India Company in one year ; at Shantee-pooru the purchases in some years amount to 12 or 15 lacks ; at Maldu to nearly the same sum, and at other places from 6 to 12 lacks. Muslins are there made which sell at 100 rupees a piece. At two places in Bengal, Sonar-ga and Vicknum-pooru, muslins are made by a few families so exceedingly fine, that four months are required to weave one piece, which sells at from 400 to 500 rupees. When this muslin is laid on the grass, and the dew has fallen upon it, it is no longer discernable. The wool, or rather hair, which grows upon the Bengal sheep is so short and coarse that a warm garment can scarcely be manufactured from it."*

"Of the exquisite degree of perfection," says the eloquent historian of British India, "to which the Hindoos have carried the productions of the loom, it would be idle to offer any description. No modern nation can vie in the delicacy and fineness of its cotton tex-

* A View of the History, &c., of the Hindoos, by William Ward, of Serampore, third edition, 1820, vol. iii. pp. 125—7.

† Forbes.

tures with Hindostan. It is observed, at the same time, by intelligent travellers, that this is the only art which the original inhabitants of that country have carried to any considerable degree of perfection. To the skill of the Hindoo in this branch of industry several causes contributed; his climate and soil conspired to furnish him with an abundance of the raw materials, and its manufacture is a sedentary employment, in harmony with the dislike of locomotion generated by the atmospheric temperature. It requires patience, of which he has an inexhaustible fund; it requires little bodily exertion, of which he is always *exceedingly sparing*; and the finer the tissue the more slender the force which he is called upon to apply; the weak and delicate frame of the Hindoo, moreover, is accompanied with an acuteness of external sense, particularly of touch, which is altogether unrivalled, and the flexibility of his fingers is equally remarkable; the hand of the Hindoo, therefore, constitutes an organ adapted to the finest operations of the loom, in a degree which is almost or altogether peculiar to himself."

"A people," says Orme, "born under a sun too sultry to admit the exercises and fatigues necessary to form a robust nation, will, naturally, from the weakness of their bodies (especially if they have few wants) endeavour to obtain their scanty livelihood by the easiest labours; it is from hence, perhaps, that the manufactures of cloth are so multiplied in Hindostan; spinning and weaving are the slightest tasks that a man can be *set to*, (?) and the numbers that do nothing else in this country are exceedingly great."

Let us beg our reader's indulgence for these frequent diversions from the thread of our narrative. He will, perchance, bear them more patiently, if he keeps in mind that they are necessary to our design, that our first aim is to inform, not to amuse, and that in reading, as in every worthy employment, the highest and almost only value of amusement, is to relieve the mind and to prepare it for graver pursuits. If the reader will remember this, we see not what should prevent us from travelling on, quietly and happily together, to the end of our journey. With this fair understanding we resume our narrative where we left it.

Bishop Doane, of New Jersey, in a letter to a friend in this city, gives a most interesting account of the remarkable inscriptions found on some ancient monuments near Adon, on the coast of Hadramant (Arabia,) and first deciphered by the Rev. C. Forster, of Great Britain. These records, it is said, restore to the world its earliest written language, and carry us back to the time of Jacob, and within 500 years of the flood,

The inscriptions are in three parts. The longest is of ten lines, engraved on a smooth piece of rock forming one side of the terrace at Hisn Ghorab. Then there are three short lines, found on a small detached rock on the summit of the little hill. There are also two lines found near the inscriptions, lower down the terrace. They all relate to one transaction, an incident in Adite history. The tribe of Ad according to Mr. Sale, were descended from Ad the son of Aws or Uz, the son of Aram, the son of Shem, the son of Noah. The event recorded is the route and entire destruction of the sons of Ac, an Arab tribe, by the Aws or tribe of Ad, whom they invaded. In Mr. Forster's book fac similes are given of the inscription; the Aditie and the Hamyaritie alphabet; and a glossary containing every word in them, its derivation, and its explanation; with notes of copious illustration upon every point which they involve. The first inscription of ten lines is thus translated:

We dwelt, living long luxuriously in the zananas of this spacious mansion; our condition exempt from misfortune and adversity. Rolled in through our channel.

The sea, swelling against our castle with angry surge; our fountains flowed with murmuring fall, above

The lofty palms; whose keepers planted dry dates in our valley date-grounds; they sowed the arid rice.

We hunted the young mountain-goats and the young hares, with gins and snares; beguiling we drew forth the fishes.

We walked with slow, proud gait, in *needle-worked, many-coloured silk vestments, in whole silks, in grass-green chequered robes!*

Over us presided kings, far removed from baseness, and stern chastisers of reprobate and wicked men. They noted down for us according to the doctrine of Heber, Good judgments, written in books to be kept; and we proclaimed our belief in miracles, in the resurrection, in the return into the nostrils of the breath of life.

Made an inroad robbers, and would do us violence; we rode forth, we and our generous youth, with stiff and sharp-pointed spears; rushing onward.

Proud champions of our families and wives; fighting valiantly upon coursers with long necks, dun-coloured, iron gray, and bright bay.

With our swords still wounding and piercing our adversaries, until charging home, we conquered and crushed this refuse of mankind.

The short inscription in three lines reads thus:

With hostile haste, the men of crime

We assailed; onward rushed

Our horses, and trampled them under foot.

The two line inscription, which is under the long inscription, in the terrace, is as follows:

Divided into parts, and inscribed from right to left, and marked with points, this song of triumph, Sarash Dzerahh.

Transpierced, and hunted down, and covered their faces with blackness, Aws the Beni Ac.

On the subject of these inscriptions, Mr. Forster, in his dedication of his book to the Archbishop of Canterbury, thus remarks:

“What Job (who, living in the opposite quarter of Arabia, amid the sands of the great Northern desert, had no lasting material within reach on which to perpetuate his thoughts,) so earnestly desired, stands here realized.” “Oh that my words were now written! Oh that they were printed in a book! That (like the kindred creed of the lost tribe of Ad) they were *graven with an iron pen, and lead, in the rock for ever*. (For mine is a better and brighter revelation than theirs.) For I know that my Redeemer liveth, and that he shall stand at the latter day upon the earth; and though, after my skin, worms destroy this body, yet in the flesh shall I see God: whom I shall see for myself, and mine eyes shall behold, and not another.”

But it is not the antiquity of these monuments, however high, which constitutes their value; it is the precious central truths of revealed religion which they record and which they have handed down from the first ages of the post-diluvian world, that raise them above all price. Viewed in this respect, they strike at the very root of scepticism, and leave not even his own hollow ground beneath the feet of the unbeliever. For, if what the infidel vainly would bring into the question, as originating with Christianity, stands here registered as the primeval faith of mankind, there is an end at once, to the idle sophistry of unbelief.” “The inscription on the rock of Hisn Ghorab, a contemporary witness of the faith of the most ancient of the old Arabians, changes the state of things, placing beyond the cavils of scepticism itself, at once, the fact and the purity of their belief in the scriptural doctrine of the resurrection; and presenting to the eye this great Gospel truth, (to borrow the language of Mr. Burke), covered with the awful hoar of innumerable ages.

“It appears, says his Holiness Pope Alexander VI. that the world was first indebted to one Arkite Ghiden Ghelen, an extremely ingenious artizan of Nodville, for the first regularly manufactured piece of cloth ever produced on the surface of this terrestrial globe; and although it was akin to what we at this day and generation call matting, and produced by twisting and interlacing leaf stems and fibres together; yet the workmanship cannot be surpassed by the best manufacturers of Bolting Cloths of the present day.” From this it would appear that his holiness had a sample of the cloth actually in his possession. Perhaps sewing the fig leaves as mentioned in the book of Genesis has reference to the same process.

“An obvious improvement on the garment of leaves, proceeds his Holiness, which was suggested by twisting the peel of rushes into fine strings by which means superior textures were produced. (See Fig.

13;) but this improvement was not adopted generally, in the part of the country of which we speak, till after the death of Methuselah.

It did not escape the notice of the mat weavers, that their work was rendered more flexible and agreeable to the wearer (particularly for under garments,) by the use of a finer fibre, and accordingly we find that numerous trials were actually made, with the fibres of various kinds of plants, such as those of the hemp and flax species."

It is curious how the descendants of our first parents obtained the knowledge of spinning flax into thread. We are credibly informed that it was by *supernatural* agency. We are indeed told by W. Cooke Taylor of Trinity College, Dublin, that a tradition exists in Ireland, which goes far to prove that spinning was first effectually practised in that country; but we disregard such testimony, as we have found the true and original story, from which the Irish one is evidently copied. This discovery we have made in the collection of Sir Henry Hunlock, and we think it right to give his version, which is as follows.

"There were once an old woman and her daughter who lived at the side of a hill, (not under a hill, as the Hibernian would fain have it) in the midst of a forest, near Nodville. They were very poor, and their only support was obtained from selling the thread which the daughter spun with her spindle and distaff. During the long winter when the roads were so bad that merchants of the surrounding nations could not come to purchase the thread. The daughter, who was one of the most lovely creatures on earth, worked without cessation, in order that she might have enough of thread when the spring market came to enable her to purchase a cloak for her mother and a scarlet shawl for herself, in order that they might be properly attired while attending their devotions. (Where these shawls and cloaks were manufactured is a question for hierologists to solve.)

"It so happened that the king of that country, whose name was Zannkul K. Euzen, had an only son, who while out one day deer hunting, went astray in the forest of Akiel, and called at the widow's cottage to enquire the way. He was greatly struck with the girl's beauty and not less with the numerous hanks of yarn which lay upon the floor of the cottage, and equally attested her skill and industry. He asked how it happened that she had collected such an immense pile, and the old woman, whose name was Zabozok, replied that her daughter had spun the whole in a week. "In a week!" exclaimed the astonished prince, "if this be true, I

have found a 'gal' more worthy of my attachment than any other in the whole country. I will send you a load of flax, and if she has it done by the end of a week, I will, *without any other proof* of her merit, choose her as my bride; but if not, I will have you both cut in pieces and thrown to the cormorants and loons, for deceiving the son of your sovereign."

"On the very next day a long train of camels, laden with flax, stood before the door of the cottage, and the drivers having unloaded them told the girl that she must spin this quantity in a week, or prepare for death. When they departed her poor heart was crushed with despair. She, however, was unwilling to reproach her mother, even by a look; but she went into the forest, and sitting down under a tree, began bitterly to bewail her sad fate. While she was thus weeping and lamenting, a decrepit old man came up and enquired the cause of her tears, and in reply she told him the whole story. "Do not weep, daughter," he said, "I will execute every one of the tasks imposed upon you by the prince, provided that you will either give me your eldest son, when he is twelve months and a day old, or that you shall in the intervening time find out my name." She agreed at once to the terms. The old man, by some mysterious agency, conveyed away the flax, and about an hour before the time appointed for the prince's arrival, (*which was half past five o'clock in the morning*) returned with the finest and best twisted thread that had ever been seen in Nodville. The prince, according to his promise, married the girl, and conveyed her with her mother to the palace, which stood upon a beautiful rising piece of ground about $\frac{1}{4}$ of a mile from the city, and overlooking it. (This palace must have been a very magnificent building, as it cost rather more than eleven and a quarter talents of gold.)

"Every Monday morning *before sunrise* the prince gave out to his *beloved* the quantity of flax which he expected to be spun during the week, and every Saturday night the yarn was made ready for him by the mysterious old man. At length the princess became the mother of a beautiful boy, and the thoughts of the bargain she had made almost drove her to distraction. Every effort she made to discover the name of the wonderful spinner utterly failed, and he at every visit reminded her that the time was near when he would have the right to claim her child.

"One evening as she sat oppressed with melancholy, her husband, who had just returned from hunting, enquired the cause of her sadness, but she was unable to answer him a word. "Come my love,"

said he, "do not be cast down, and I will entertain you with an account of a very surprising incident which occurred to me this very day. I lost my way while pursuing a fine stag which ran towards the great rocks beyond the forest. While searching for his lurking place, I thought I heard a human voice, and following the direction of the sound, came to a cave, where I saw an old man, who did not notice my approach, so deeply was he engaged in a strange sort of labour: he was spinning, not as you do with the distaff, but with wheels which flew round as rapidly as lightning, and gave out thread like water falling from a mountain torrent; and all the while he never ceased singing,

My mistress, little she knows my name,
Which shan't be forgot, which shan't be forgot,
When a prince as heir to the fortune I claim
Of Wallotty Trot, Wallotty Trot.
I'll come at the end of a year and a day,
And take the young prince, my heir, away.
With my whack! she goes!
While nobody knows;
My trusty machine,
In this cave unseen:
Here is the spot
For Wallotty Trot!

"The princess made her husband repeat the rhymes several times, until she was sure that she could remember them perfectly, and waited with confidence for the return of the old man. He came at the appointed time, and claimed the child. 'Stop neighbour,' said she, 'there goes another word to that bargain. I have found out your name: It is Wallotty Trot.' 'You have indeed detected my name,' said he, 'and my business on earth is well nigh finished; but before I depart I am bound to tell you the secrets of my art.' So saying, he went into the forest, and in a few seconds returned with his wheels. He then taught the lady their use, showing her that she could spin a *thousand times* more with them than she could accomplish by means of the distaff; and then vanished; after which he was never again seen in that part of the world.

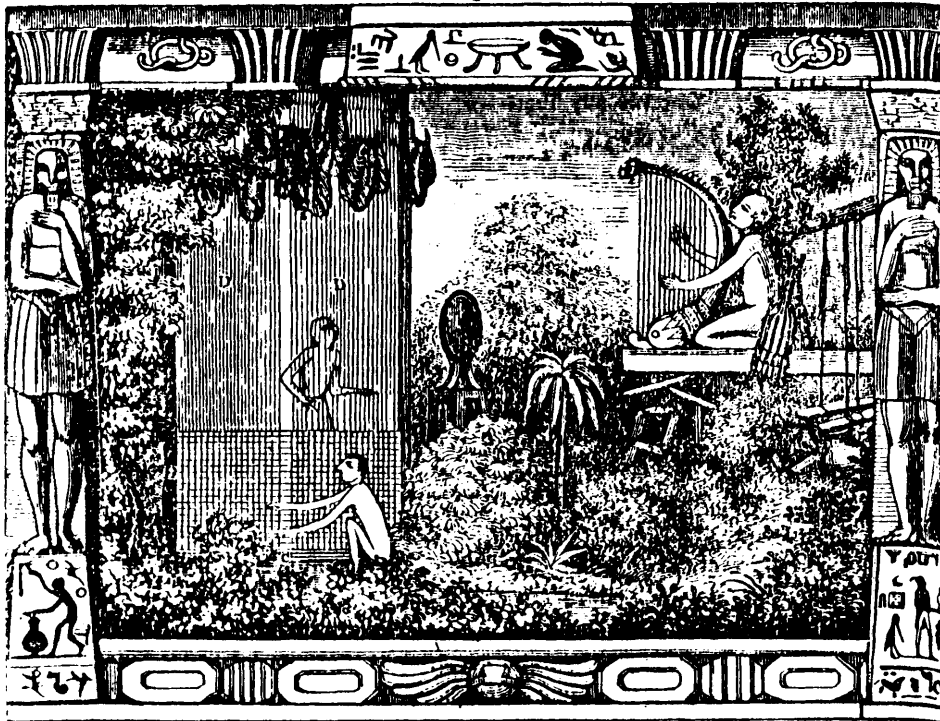
"The prince and princess taught this new branch of industry to their subjects, which so enriched them that all the surrounding nations regarded them with envy and admiration."

These wheels are of similar construction to those introduced into Great Britain by Samuel Crompton, which are known by the appellation of the 'hall-in-the-wood' machine. It is unnecessary for us to give drawings and descriptions of them, Mr. Baines of

Leeds, and Dr. Ure of London, in their histories of the progress of the cotton manufacture in Great Britain, having already done so.

After the death of Methuselah, the art of weaving appears to have made considerable advances in many parts of the East, and particularly in China, India, and Persia. The first loom of which there is any authentic record still in existence, is that invented by Arkite Ghiden Ghelen, when a lad of about seventy years of age; and after having been at great trouble and expense, we have succeeded in procuring a drawing of it, copied from an ancient parchment scroll, found among the curiosities of *Sesac*, founder of the Egyptian dynasty, (who reigned thirty-four years.) But from the dilapidated state of the document, and the draughtsman (Alexis Kersivenus of Alexandria) not being a weaver himself, we fear it is not in every particular like the original. This scroll appears (from indorsements on its back) to have been once in the possession of the emperor of China, Teling Ching Ouang, from whom it descended to Chao Kong-hi-hi, his successor.

Fig. A.



is a representation of the loom, &c., which is of vertical construction, and seems to have been chiefly applied to the manufacture of plaids

and chequers ; the patterns of which were most probably suggested by the interlacing of bark or stripes of broad leaved plants. Indeed the modern plaids so obviously represent this origin of their patterns that no one except the most sceptical can for a moment doubt the correctness of this opinion.

The process of weaving in this loom must have been very tedious, and of course the fabrics produced would be expensive in the same proportion. The inventor does not appear to have been acquainted with any instrument analogous to the shuttle, for we find from the perusal of ancient records (imperfect as they certainly are) that some weavers drew the weft through the web with their fingers, and others used an implement somewhat like a knitting needle, but having a hook at one end, similar to the crook of a shepherd's staff, which doubtless insinuated the first idea of that most useful instrument.

The frame work consists merely of two posts, each $4\frac{1}{2}$ inches in diameter, which are indicated in the figure by the letters BB. Between these posts the yarn and cloth rollers are placed. The cloth roller C, may be seen at the bottom, but the yarn roller at the top is not shown in the drawing, although its proper position is evident enough from the manner in which the warp threads DD, descend. Two persons, the one a male and the other a female, are employed during the operation. The former of these is behind the web, in a standing attitude, and is looking as if provoked at having spoiled some part of his work, which, in all probability, the woman in front is adjusting, to pacify the old churl ; perhaps, however, he is calling for more weft. These are only suppositions of ours, and the reader must solve the vision for himself, *in all its other phases.*

We almost forgot to mention that young Teague Ghelen, who is playing on the harp, is only $3\frac{1}{2}$ years of age, and seems, although so young, to possess an uncommon share of musical skill. His instrument is one of great tone, being far superior to the Irish harp ; and it does not differ materially in its construction from those made by their originator, Tubal cain. In point of symmetry, it is not surpassed even by Tom Moore's No. 1.

We would also add, that the various figures composing the border of this drawing, cannot now be explained, at least until we hear from our friend, Lepsius, to whom we have written for some information respecting them.

We subjoin a few spirited verses, from a well known author, in

compliment to the inventor of this simple, but ingenious weaving apparatus :

“ Great genius of the ancient times !
A loom like thine was well worth leaving ;
To thee, what are our feeble rhymes ?
First master of the art of weaving !

Between two trees thy web was hung,
Thy cloth beam nearly touch'd the ground ;
While birds, enchanted, sweetly sung,
And fruits, delicious, grew around .

Thou breath'd the freest air of heaven,
The sun, unclouded, gave thee light ;
No lamp, nor gas to thee was given ;
Through day thou work'd, and *slept at night !*”

(*Brien Dhu O' Farrell.*)

We shall now turn to examine some other kinds of weaving machinery, &c., and in doing so our readers may rest assured that our information has been obtained from the most correct sources ; but, at the same time, we do not hold ourself responsible for any errors that may have been made by the respectable historian, Deioces, the first king of the Medes, from whom our correspondent (Alexis Kersivenus of Alexandria) copied the specification and drawing which we are about to present. * * * * *

“ While,” says his Majesty, “ engaged with state affairs, on the ninth day of the month Adar, in our royal palace at Ecbatana, * * * dog from the land of Shinar, who called himself *Arphaxad*, came unto us begging the loan of our royal ears, while he would describe the nature of a wonderful engine of his invention, and which the said alien pronounced in our hearing to be a creature of surprising capacity, and likely to add to the welfare of our beloved subjects. We, being at all times disposed to facilitate as much as in us lies, so desirable an object, of our grace and clemency did lend unto the said infidel the use of our royal ears, thereby enabling him to approach within nine cubits and a span of our most high Majesty to explain more clearly to our *perfect* understanding the peculiarities of the animal.

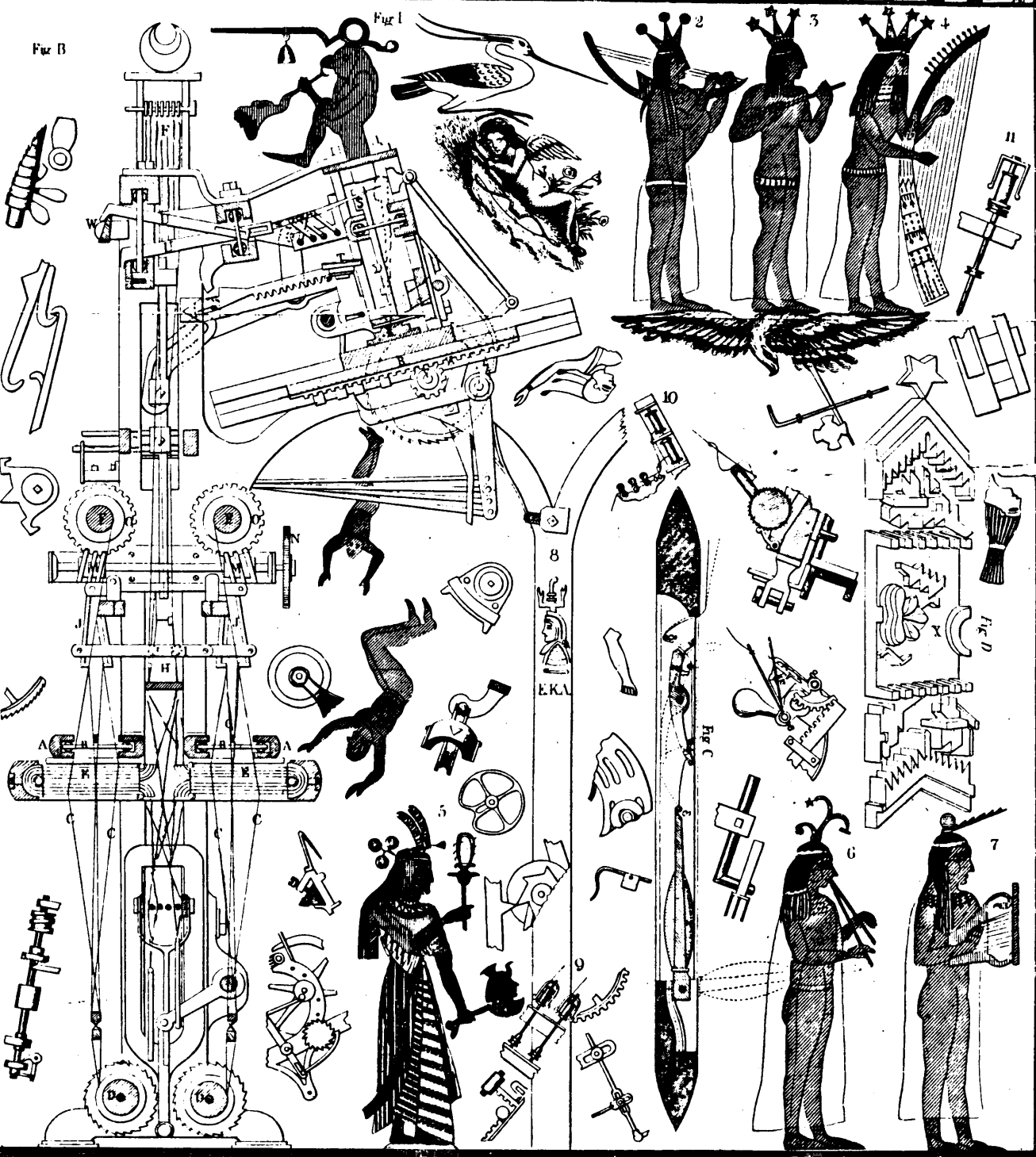


Fig. B

Fig. 1

2 3 4

Fig. D

Fig. C

EKA

Scale 1/4 inch to the foot

Copyed from the original by Marcus Aurelius Maximus (Egypt)

While the barbarian was about to proceed with a description of his mechanical monster, we issued our mighty mandate, calling upon our trusty scribe and penman, Deog, to appear before us, and to copy down *verbatim* the whole of the Oration, as delivered with fear and trembling in our royal presence, by the said heathen, whom at the same time we commanded to speak slow, that no errors of judgment might be made. We here give in our most excellent History, for the good of our well beloved subjects, the words as recorded.

O most noble Deioces ! Great monarch of the Medes, whose laws change not ! Much to be dreaded ! May it please the King's most excellent majesty, I, an humble descendent of our great father Noah, have invented, arranged, and worked, after having experienced sixty-five years of sore toil and anxiety of mind in this vale of tears, a weaving engine to be driven by the power of compressed air, and which, O King, I now beg leave to explain.

May it please your Majesty,

My invention, with all its combinations, parts and appurtenances, is applicable, either separately, or conjointly, as the nature of the case may be, to the manufacture of *all sorts* of cloth, whether plain, tweeled, or figured. The arrangement which I propose to employ, consists in improvements on a weaving apparatus, invented in the days of Haran, the father of our unfortunate brother Lot, who once lived in Ur of the Chaldees, * * * *

*, and which loom or contrivance bore the title of ' Ghelen's vertical mat loom.' But it is unnecessary to enter into a description of it, as the looms constructed according to the present improvements have such *different* properties from the said Ghelen's, as to have very little in common therewith, excepting in the circumstance of the cloth, during its formation, extending in a vertical plane.

The main object of the present improvements is to enable me to weave four, or more webs at one operation ; and yet my machine contains but one lay, with suitable contrivances for moving it, alternately, upwards and downwards.

And may it please the King,

Figure B, represents a vertical section of the creature, taken transversely through the lay, A, which is placed in a horizontal position, with two reeds B B, in it, one extending across the loom at the front, and the other at the back. Each of these reeds is adapted to weave two, or more pieces of cloth, from one of the warps, C C, each of which warps, by means of a division in the centre of its reed, and an extraordinary arrangement of the headles, is divided into

two, or more distinct sheds, through which shuttles are to be thrown, leaving a weft thread, or threads (as the case may be) in each of the sheds.

And, may it please the King,

The warps of these webs, are to be wound upon two rollers D D, placed at the bottom of the loom, and parallel to each other: the threads which proceed from them, are conducted upwards through the headles, which are extended horizontally, then into the reeds B B. The threads so proceeding from each warp roller, are now divided into two, or more series, for weaving distinct pieces of cloth; and for this purpose, the surface of the dents of each reed, is divided by means of a long narrow ruler, (which is secured across the dents) extending the entire length of the reed, so that the surface which the dents present, is divided into two, or more parallel shuttle races. There are in all four, or more of these races, for the passage of as many shuttles, which are to be thrown (with great precision) by a simultaneous motion, through the several sheds open for their reception. The warp threads, as they come from their respective rollers, are conducted up through these shuttle races. The headles E E, are tied across the loom from front to back, beneath the reeds, and every headle has two, or more eyes in it, at suitable distances apart, to receive as many threads of warp, one of them belonging to the front warp roller and front reed, and the other to the back set. Each headle operates upon two, or more of the webs, which are to be woven at once; and by working them, all the warps will be divided, and opened into sheds, at the same instant. The lay, with its reeds, remains stationary, at its lowest descending point, while the shuttles are passing through the sheds; but, immediately after they have made their exit, it begins to ascend, carrying up with it the weft threads. The sheds are all closed by a suitable action of the headles, while the lay is ascending, and when it reaches its highest position, the reeds knock up all the weft threads between the closed warp.

And, may it please the King,

The fabric as it is woven is drawn upwards, and wound round the cloth rollers F F, one at the back, and the other at the front of the loom, and corresponding to the warp rollers. The accessories, and new improvements which are proposed to be applied to vertical air-loom, according to my invention, for the purpose of weaving four, or more webs at once, in the same machine, are as follows.

1st. In order to avoid stopping the motion of the loom when one or more of the weft threads break, or become exhausted, a few spare

shuttles are to be lodged in suitable receptacles, which are so arranged, that the mere breaking of a weft thread, will cause a change of shuttle instantaneously, (by the substitution of a spare one in its stead.) The method by which I accomplish the operation is this :

On a weft thread breaking or becoming exhausted, the corresponding shuttle will be jerked out of the lay, into a sluice, made through the back side of the machine, and from thence conducted to the 'catcher,' at the lower end of the weaving room, or at some other convenient place, (as the case may be) where it is refitted with a new cop or quill, put into what is generally designated 'Nahor's air fly,' in which is a cylinder containing a moderate quantity of compressed air. On the shuttle being entered at the top of the fly, (exactly in the same way that bullets are dropped into 'Perkin's steam gun') it descends into the return conductor, where the end of a rod, not unlike the suction-rod of one of your Majesty's garden pumps, is brought to bear against it ; but, that the point of the shuttle may not be injured by the sudden action of the propeller, the latter is hollowed out to fit the end of the shuttle, to about two-thirds of the nib's length, and the shoulder thus formed will prevent any little mishap of that nature, which might otherwise occur. The shuttle being thus made ready, the cop tender (bobbin winder) tips the 'let off,' whereupon that shuttle speeds its way to replace some one of its fellows, that has become exhausted, and thus a uniform system of operation is constantly kept up.

And, may it please the King,

That if by neglect of the cop tender, the receptacles be not provided with spare shuttles, nevertheless the loom will stop of its own accord : the arrangement by which this is effected is as follows :

The shuttle, Fig. C, is provided with a spring dent 1, the end of which, nearest the cop 2, is made heavier than the other, and is kept raised by the tension of the weft thread, when unbroken ; which thread passes over the pin 3, through an opening (or eye) at the end of the detent, and over the studs 4 and 5, then through a hole at the lightest end, passing under the pin 6, and out at the eye 7. Thus, on the breaking or failure of the weft thread, the weightier end of the detent, being no longer upheld, will lie on the bottom of the shuttle elevating the other end, which on entering the box or cell, forces back a projection that protrudes through an opening in the picker : and this projection on being forced back,

acts upon a series of levers, which cause the cells containing this shuttle and its fellows, to move towards the right hand side of the loom, their places being filled by the two adjoining cells, containing spare shuttles. This operation is repeated on the breaking, or failure, of a weft thread, as many times, as there are pairs of spare shuttles provided (say *eleven* times;) but, if by the neglect of the tender, in not replenishing the cells with spare shuttles, (as I before stated,) the whole number has been exhausted, and another change is yet required, then, the safety regulator will, by means of a lever, draw out the connecting pins from the lay arms, on the main driving shaft, which pins keep this shaft attached to the working parts of the loom, and as soon as this is accomplished motion will be suspended.

2d. And, may it please the King,

The arrangement of the headles or what is called the mounting of the loom, is so contrived as to be suitable for weaving four, or more webs of plain cloth at once; but it admits of introducing a greater number of headles, than the two which are requisite for plain weaving; and, in fact, the mechanism by which they are worked (*with a slight variation*) admits of weaving any kind of tweeled cloth, by means of *any* convenient number of headles.

3d. And may it please the King,

The loom is also provided with substitutes for temples, for the purpose of keeping the webs of cloth properly extended, during the operation of weaving: they are a sort of pincers JJ, of which there are four, or more pairs, two, or more, at each side of the loom. After the shuttles are thrown, while the sheds of the warp are closing, and the lay is moving up towards the cloth, the jaws of all the pincers are closed by the wedge-like piece H, attached to the rod I, which moves the lay up and down. This piece H causes the two rollers shown by the dots, to recede from each other, and to close the pincers upon the selvages. The moment the picks of weft are knocked up by the reeds, the lay descends, the pincers advance towards each other, and their jaws are again opened, ready to grasp their several selvages as before.

4th. And, may it please the King,

The warp rollers DD, are loaded with only small retaining weights, (applied as in said Ghelen's loom) in order that the friction thereby produced may occasion but a slight resistance to the rotation of the rollers, as the warp is drawn off by the gradual formation of the cloth. A ratchet wheel is fixed upon one end of each warp roller, and two clicks are so connected with the machinery,

which carries the lay up and down, that as it is rising to knock up the weft, and while the sheds are closing, each of the clicks will be brought into the teeth of the ratchets, and will turn the warp roller round as much as is necessary to wind it back to a suitable tension ; but as the lay descends again, and the warp requires to be opened into sheds, the said clicks are withdrawn by the machinery, from the teeth of the ratchet wheels, leaving them at liberty to yield and give off more warp. Each of the cloth rollers gathers up two or more pieces at once, and consequently it will increase in size faster than said Ghelen's loom, which winds up only one thickness. The mechanism for turning the cloth roller round adapts itself to this circumstance, so as to take up the cloth at the same rate when the rollers have become larger, by the accumulation of cloth around them, as when they were smaller. This is effected by the following means :

They are turned by the screws or worms M M, taking into the teeth of the wheels O O : the screws or worms receive their motion from a ratchet wheel N, affixed on the same axis : this ratchet wheel is turned by four clicks, or drivers, attached to a lever, having an ascending and descending motion. This motion is regulated by a rest that rises from a rod, which is parallel with the roller, and bears upon the cloth wound upon it, so that as the roller increases in diameter, the rest, being raised, will limit the descent of the lever above mentioned, and thus the cloth rollers will be turned with a continually diminished speed.

5th. And, may it please the King,

By means of other mechanism for changing shuttles, the webs may have cross stripes, of different colours of weft yarns, or of different strength and appearance. For this purpose the several sets of spare shuttles being charged with different kinds of weft, will occasion like changes in the web, so as to produce cross stripes, which may, also, be combined with longitudinal stripes of various colours, or strength of warp thread, or threads (as the case may be) suitably arranged in the previous operation of warping ; so that by combining cross and longitudinal stripes, chequered patterns may be produced, which in many respects *differ* from those made in Ghelen's machine. The shuttle boxes, or receptacles for the several shuttles, which contain weft of different colours, have as many cells, situated one over another, as are required for the reception of the several sets of shuttles ; and they are raised or lowered by means of a series of levers, suspended on the axis P, at the top of the loom, the boxes being hung, one from each end of a lever. These levers re-

ceives their motion from another series which are operated upon by a revolving barrel, placed above the cloth rollers, (but not shown in the drawing.) This mechanism raises or lowers the boxes, just as much as is necessary, in order to bring the particular set of shuttles wanted, to a proper level for being propelled through the several sheds.

5th And, may it please the King.

The above described mechanism can be readily altered, so as to operate with different orders of succession, thereby producing a great variety of patterns; and also, with a new plan of mounting the headles, adapted for figure weaving, combined with new figuring machinery, the four, or more webs, which are to be woven at once, may have ornamental patterns upon them of the nature of what is termed 'fancy weaving.' Or, in lieu of the said figure weaving machinery, I apply a peculiar combination of suitable parts, which receives the diversification of its action, from a pattern board X, which is shown on a large scale, at Fig. D. Upon the flat surface of this board the design is carved in *relief*, the parts which are to exhibit the sundry colours being cut down to different corresponding depths. The pattern-board is now placed in its situation at the upper part of the loom, as shown at X, its carved surface being presented beneath the under extremities of a row of needles or small slides S, which stand side by side in vertical positions. These needles, severally, (at certain intervals of time) during the operation of the loom, are let fall upon the said carved surface, and by the inequalities of the relief, some of them are allowed to drop lower than others. Those which are sustained by the more prominent parts of the carving, are acted upon by a straight edge or rule T, placed horizontally across all the rows; which straight edge, being taken backward when required to act, comes in contact with certain lateral prominences in the needles, so as to push back all those which are prevented from falling, by carving on the pattern-board. Each needle is connected with, or tied to a lever U, which levers are placed transversely over the loom, their back ends bearing upon a fulcrum. One, or more of the headles are suspended from each of these levers, near to the middle of its length; and all the levers being thus placed side by side in a row, at the top of the loom, their front ends form a row across the loom, until some are drawn back with an endway motion upon their fulcrum, by the straight edge, T, acting upon their corresponding needles.

The front extremities of those levers which are not drawn back, are lifted up by the edge of a horizontal lifting bar W, which rises

upwards, when the sheds of warp are being opened ; and in rising they pull up those headles which are connected to them, by which means a proper selection of warp threads, to form the pattern, is effected.

By the different depths of carving on the pattern-board X, the needles are thus divided into several series, which are acted upon successively, by the straight edge T, in order to produce a change in the selection of warp threads. The pattern-board is fastened upon a moveable table R, which is shifted either backwards, or forwards (in a slow progressive manner,) by the pinion Y, taking into the rack Z, attached to the under part of the table. This pinion receives its motion from two ratchet wheels fastened on the same axis, and these wheels are turned by drivers.

7th. And, may it please the King,

Each time the pattern-board moves, the needles are raised and let fall again, so as to come on a different part of the pattern, by which means another selection is effected. As soon as the pattern board has been conducted along its whole range, and the figure transferred to the cloth, all the needles are lifted up ; whereupon the board returns to its first position, with an instantaneous movement. Should the board have only half the pattern intended to be woven, carved upon it, as soon as that is worked up to its last line or change then, the action is reversed, bringing the needles on the second line of the board, which is now worked backward, with the same speed that it went forward, and thus the other half is produced. Patterns consisting of two similar halves, need only half the carving of those described in a former instance.

And, may it please the King,

Instead of the above, the pattern may be carved on the circumference of a cylinder, which is in all respects the same as those formerly constructed by our relation, Jubal, the organ builder, (see also Genesis, iv. 21.) mounted on a horizontal axis, and turned round with a slow progressive motion. If the pattern is exactly the size of the cylinder, as soon as the latter has been once passed under the needles, it will return to its first position ; but, if only half the pattern covers it, (the other half being a repetition of the first) then, as soon as it has made one revolution, it returns in an opposite direction, and so on, alternately.

To produce a variation in the succession of the changes of the shuttles; a portion of the carved surface of the pattern-board, or else a *distinct* pattern-board, must be provided, and carved with alternate elevations and depressions, for lifting their several elbow

levers, and the levers below, which are connected with stop detents, for detaining them, and determining their positions. The revolving barrel, before mentioned, may also be applied for effecting the raising or lowering of the shuttle boxes, in a *proper manner* to change the shuttles, and produce cross stripes; as the position into which the revolving barrel, is turned and detained, previous to every succeeding pick of weft, determines which of the different colours of weft, shall be thrown.

And, may it please the King,

The mechanism of the figure weaving loom will be simpler, if the plain or tweeled ground of the cloth is produced by a distinct apparatus. To effect this, those headles which belong to the yarns that are to form the warp of the plain ground, are united to a few *lams* (thin shafts of wood or iron) so that by drawing up one of these a number of headles may be raised together with one motion. The lams are to be suspended from horizontal levers at the top of the loom, in a similar manner to the levers U, and disposed in the same row.

It was before stated that only one or two headles were suspended from each lever; but, by means of the lams, several may be suspended from each of them. These are provided with needles similar to the others, and which *might* be actuated by being dropped upon a suitable part of the surface of the pattern board; but, as this would only produce a repetition of a simple series of changes, *I prefer to substitute instead, a small cylinder or revolving barrel*, the surface of which is carved into a series of suitable prominences and depressions in order to actuate the needles, in a similar manner to the pattern cylinder before described.

And, may it please the King,

Whereas, cylindrical barrels, studded with projecting pins, similar to the organ barrels of said Jubal, have been used in different parts of your most gracious Majesty's dominions, for *other purposes than that to which I propose to apply them*, I, therefore, make no claim to the invention of such barrels, *except* when the same are applied to my figure weaving machinery, of the kind before described, with needles and other necessary parts, for weaving four or more webs at once, in the same vertical power loom; and also when the surface of said barrels are carved with different heights and depths, at all parts which are to be represented on the cloth with difference of colouring. I would *remark also* that when small patterns are to be produced upon the cloth, I use, *instead* of the said machinery, (for working any reasonable number of leaves of headles) a contri-

vance or invention, which I call a *tappet* wheel, formed of a suitable number of segment pieces of iron or smooth stone, in the faces of which segment pieces, indented grooves are made or cast, for the purpose, when combined, of producing a zigzag groove round the face of the wheel, to suit any required pattern to be woven in the cloth. In this zigzag groove a roller works, attached to an upright rod, which is connected to the levers or treadles; and, hence, as the tappet wheel revolves, the treadles are worked up and down, according to the elevations and depressions formed in the wheel, and the requisite portions of the warp are raised and depressed to form the sheds.

The segment pieces are all made to correspond and to fit together in the wheel, so that they may be readily changed, and a different zigzag groove produced when required, according to the sort of cloth to be woven, thereby superseding the necessity of casting or making many wheels, having different shaped grooves, and of shifting them where any variation in the weaving is wanted. The rod which holds the roller that works in the tappet, is connected above to the two outer jacks, as in the ordinary power loom, and acts upon vertical rack bars that take into a pinion, which raises and depresses the portions of the warp equally, and thereby prevents any *under strain*. There are certain vibrating bars connected with the jacks and with the needles, which are thrown from side to side by the action of the tappet rod on the racks and pinions; and these bars have notches in their edges, which are taken hold of by horizontal bars connected to the treadles, for the purpose of moving or holding back certain of the needles, agreeably to the command of the tappet wheel. The rising of the tappet rod, and the rack bar, works a crank that slides the pattern board, and brings the successive lines of the pattern under the ends of the levers or needles; and a spring is introduced to ease the action of the pattern frame.

And, may it please the King,

I also claim the *honour* of inventing a new arrangement of mechanism, *which has no connection whatever with any part of my machinery already described*, but yet is so *essential* to the general well-being thereof, that I cannot resist the temptation of explaining it *separately*, and claiming it in combination with the former (notwithstanding the claims of the said Ghelen.)

The leading feature of this improvement consists in the peculiar arrangement and order of working certain parts of looms in general, so that a new description of cloth shall be produced or woven; and it is more particularly adapted to that class of silk fabrics called

'Kiang Nau'* satin; the ordinary quality of which has one face highly finished and glossy, owing to the brilliancy of the warp threads being thrown up on one side or surface, while the reverse or *back side* of the cloth presents a dull unsightly appearance, owing to the absence of the warp threads to the vision. Now, by the aid of my improvements, in the arrangement and order of working the loom, and by introducing a double set of warp threads, I am enabled to produce a very *extraordinary* description of goods, both in point of texture and quality; the great novelty of which consists in its having a perfect or distinct finished surface on each side of the fabric; and I am enabled also to present, two entirely different colours of cloth, one upon each side or surface of the piece, without the slightest variation in finish, brilliancy or appearance otherwise, but being, as it were, a double cloth, having two perfect sides or surfaces, and bound or held together, by threads of weft at *certain intervals*. The manner in which such manufacture is to be effected is *entirely* dependant upon the peculiar order, or succession of working the treadles, so as to divide or 'shed' the two, or more coloured warps in such a manner that a certain number of threads shall always be 'floating' to cover the weft on each side, and also a proper number of threads, only, shall rise and fall at certain intervals, to bind the picks. All this I accomplish with the aid of the tappets, as already *recorded*, the treadles being worked by them in order to open the proper sheds.

The warp threads are to be prepared and wound upon a beam as usual; but in case the cloth is required to have two distinct colours, (that is, one upon each side or surface) *then, the warps must, of course, be of the colours of the intended satin*. I would also remark, that the satin or glossy face may be produced, by the weft instead of the warp; and this may be effected, simply, by lifting *one* headle out of every eight, for the upper cloth, to each pick of the weft; by which means $\frac{7}{8}$ ths of the weft, will show on the face, instead of $\frac{7}{8}$ ths of the warp, as in the former plan. The under cloth satin face, may be produced by arranging the tappets so as to lift $\frac{7}{8}$ ths of the warp, leaving $\frac{1}{8}$ th part down, and thus $\frac{7}{8}$ ths of the weft will be thrown on the under side, as it was above in the upper cloth.

And, may it please the King,

Having now described the nature of my inventions, or improvements in looms worked by the power of air, or any other agent of

* *Kiang Nau*, the name of a Chinese province.

nature, which may be hereafter found out, procured, or otherwise brought into existence, for the purpose already described, viz., of weaving four, or any other number of webs of cloth at once, in the same engine or verticle power loom, or looms, by simultaneous action of the various parts, combinations, and appurtenances thereof, in the manner, O King ! before described and set forth ;

1st. I desire your Majesty to understand that I do not claim as my invention or inventions, improvement or improvements, combination, or combinations, the whole of said machinery ; as many parts thereof are of the said Ghelen's invention, and in *common use* ; but what I more particularly mean to confine myself to, and that which I wish to be *considered* the honourable inventor of, while I live in this world, is, first,

The reeds BB, for knocking, or pounding up the weft, or wefts of four, or any other number of webs ; such reeds being contained in the same moving frame or lay, or otherwise affixed as the nature of the case may require, and each of them being divided into two, or more separate shuttle races (for weaving half the number of webs,) and the headles dividing the warps, being adapted for opening the same into four, or more sheds.

2d. And, may it please the King,

I claim as my invention, the mechanism described for changing the shuttles, in a vertical air loom, for weaving four, or any other number of webs at once. When any one, or more weft thread, or threads break, or fail, the said mechanism then substitutes a spare shuttle, or shuttles by an instantaneous movement, without any act of the attendant, and without stopping the loom. I also claim the *peculiar* method before described, of forcing or pitching the shuttles, as fast as the weft thread, or threads break, or become exhausted, into a sluice, or conductor, cut through the back side of the machine, in the manner and for the purpose set forth. And, moreover, whereas, various contrivances have been before applied in shuttles, so as to cause the loom to cease operation, when the weft thread breaks or fails, I make no claim to the invention of a motion in the shuttle, for the purpose of causing the loom to stop, but only to the mechanism which changes the shuttles for others containing weft thread, or threads, and that too without stopping the loom.

If by any untoward circumstance, the loom should not stop when required, notwithstanding all these precautionary measures, the linch pins or keys, (as before described) are drawn from the arms which connect the lay to the main driving shaft of the machine ;

when this is accomplished, motion *will be effectually suspended*. All these arrangements I claim to be of my invention.

3d. And, may it please the King,

I claim the improvement, before described, of applying and combining, or otherwise arranging four, or any other number of moveable pincers or crabs, for extending, widening or stretching (in breadth) the cloth of four, or more webs, which are to be woven at once, in a vertical, or *any other kind of loom*, the said Ghelen's vertical mat loom excepted.

And, whereas, a kind of pincers, or crabs have been applied to ordinary looms, (which weave one piece of cloth at a time) for the purpose of holding such cloth, in their claws, jaws, or gums. (as the case may be) to the same width at which the reed leaves it, after having beaten in the west, such *nippers* having been invented by Lemuel P. Arybas (a sojourner in the Cities of the Plain) I make no claim to them; but only to the application of my apparatus to vertical looms, propelled by the power of air, or any other agent, for weaving four, or more webs at once; *nor do I mean to confine myself to these particulars*, but will be governed by the nature of the work to be produced.

4th. And, may it please the King,

I claim the improvement, before described, of mechanism for changing the shuttle boxes, from one side of the loom to the other, when all the west in such shuttles as are contained in a receptacle, has become exhausted; and also that of replacing such receptacles, charged with another carriage full of shuttles, containing cops or quills of different colours, or appearances, as the nature of the case may require, for the purpose of producing cross stripes, or chequered patterns of *every possible* description; and also, for effecting *all* changes of colouring, or appearance as are required in figure, or ornamental weaving.

5th. And, may it please the King,

I claim the improvement, before described, of the mode of mounting the headles, suitably for figure weaving, in a vertical power loom, by which four, or more figured webs of cloth may be woven at one and the same operation; and, lastly, O King! I claim the improvement, or combination of mechanism, before described, for drawing up the headles, suitably for weaving figured patterns, in a vertical power loom, on a surprising number of webs at once; which mechanism derives the diversification of its successive actions on the headles, from a carved pattern board, or from carving on the circumference of a revolving cylinder, that carving being a repre-

sentation of the required pattern, in relief, with different stages in the heights and depths thereof, at all the parts which are to be woven with different colours, or with other variations in appearance, as may be derived from changing the kinds of web which are employed; and I also claim, as of my invention, the tappet wheel contrivance or apparatus, before described, for working any *reasonable* number of leaves of headles, the claims of the said Ghelen, and of the said Arybas, to the contrary notwithstanding.

And, may it please the King,

I also claim the *honour* of inventing the improvement in looms for weaving in the same piece of cloth, two, or more pieces of *imitation Kiang Nau satin*, or fabric having two equally perfect and finished sides or surfaces, either of similar or distinct colours, qualities, or materials (as the case may be) the claims of the said Ghelen to the contrary thereof notwithstanding.

After hearing the Oration of the said Arphaxad, we ordered him to be rewarded with an annual pension of forty-five shekels of gold, in lawful money of these realms, during the natural period of his existence in this world; and we commanded a short Document to be drawn out by our scribe, to be regularly signed by the inventor before witnesses (he being a barbarian) and to be affixed to the description of the monster, as copied word for word by Deog. We condescend to add in our History this document, which is as follows:

All these arrangements, improvements, and combinations of mechanism, I claim as of my invention, the claims of the said Arkite Ghiden Ghelen, or of the said Lemuel P. Arybas to the contrary notwithstanding; in testimony whereof I hereunto, on this tenth day of the month Adar, set my hand and seal,

E. K. ARPHAXAD.

Witnesses } ZIFF DEOG, R. S.
 } ERBIL HAZER, J. P.

We have received the following letter from our friend at Alexandria (Egypt,) who furnished us with the foregoing specification and drawing, in answer to one we wrote to that polite gentleman on the 22d January last, and in which we made various enquiries respecting the several human figures, &c., represented in the draw-

ing with Arphaxad's machine, but of which the historian (we regret to say) gives no account. Mr. Kersivenus, being well versed in such matters, explains nearly all these important omissions, in the present letter.

Alexandria, April 23d, 1843.

Dear friend,

I received your favour this morning, bearing date 22d. January last, the contents of which I duly note. In the first place, I am happy to hear of the safe arrival at New York, of the drawing of Arphaxad's loom, which I had the pleasure of sending you on the 11th August, 1842, and the procurement of which gave me no small trouble, besides, the immense expense levied by his Highness before I was permitted to copy from the original scroll. But, now that you have received the drawing, which is faithful in every particular, I entertain no fears of your success, well knowing that such an enlightened people as the natives of the United States of America, have the proper spirit to appreciate your exertions to benefit them in their manufactures, by the introduction of this most useful engine amongst them. However, this is no business of mine; and my object at present is to answer your letter.

You enquire the reason why I did not (in my letter of 11th August, 1842,) give you an explanation of the various human figures represented in the drawing along with the machine. Why, my dear friend, the truth is, I forgot to do so; and I now beg pardon for having been guilty of so great an omission.

In answer to your first enquiry as to what the figure No. 1 is, and for what purpose, he is perched upon the top of the loom, I would state, that it is not a human being, as one might at first sight suppose, but only a part of the mechanism called the *alarm loon*, for the purpose of giving notice to the weavers, when a weft or warp thread breaks, in case the other motions fail to perform their respective functions, as described by the inventor before king Deioeces. The manner in which the loon operates is as follows:—

There is an air cistern, or cylinder, placed transversely at the back of the different warps, having 3796 holes of $\frac{1}{4}$ inch in diameter pierced in it; to each one of which holes, a small tube is soldered of sufficient length to reach up to the under extremity of the figure No. 1, passing into that part of the machine on which it is seated, and from thence into his interior. This arrangement being clearly understood, the operation will be obvious after a little ex-

planation. There is a small valve or air latch on the side of each of these tubes or air conductors, just about $2\frac{1}{4}$ inches from the cylinder. To each of these latches, the end of a small cord or wire chain is made fast, the other end having an eyelet hole in it, to admit a warp thread to pass freely through it. This done, the next thing is to attach a small lead of about 2 ounces in weight, and $5\frac{1}{4}$ inches in length, midway between the valve on the side of the air tube and the warp thread. As soon as a thread breaks, its cord, is of course, disengaged, when its weight is allowed to drop through a small hole in a plate, which serves to guide all the weights, and by its descending force, depresses one end of a lever which acts upon the safety valve, (corresponding to the thread,) and by this means a sufficient quantity of air is allowed to escape from the general reservoir, which instantly rushes into the figure No. 1; whereupon that figure, by the aid of a very ingenious piece of mechanism in its inside, elevates the trumpet, and gives a shrill blast, loud enough to be heard all over the factory.—A similar method is employed with the weft threads, but this I shall explain to you in another letter, as soon as I hear from our friends, Dr. Lepsius, and Mr. Taylor of Dublin, to whom I have written on the subject. Should more than one thread break at a time, the mechanism of the figure No. 1, adapts itself to that incident, by giving a corresponding notice; should any serious accident occur, such, for instance as any of the workmen who are occupied inside of the machine falling through the rigging, by reason of having made a mis-step, then, the alarm loon blows five times in rapid succession; and in case of two hands falling over-board at the same instant, as is represented in the drawing, the trumpeter blows *eleven* times, lifts his reserve foot, kicking off his ring hat, under which all the tubes from the safety-valves in the main cylinder fit, whereupon the whole of the air escapes through the lid in the crown of the loon's head, and thus the loom is effectually stopped until new hands are provided.

I am credibly informed by his Highness, that in no instance do any of the poor fellows survive a fall from the engine, and, indeed, it is an astonishing fact, that life almost invariably becomes extinct before they reach the ground at all. It appears from the original records in the possession of his Highness, and from what I, myself, could decipher from *other* documents, in regard to the rise and progress of this desperately complex machine, that out of every 76 persons who met a horrid death through its instrumentality, 65 were apprentices (or green hands.)

There is not the shadow of a doubt on my mind, however, that

you will in the course of a short time, so improve the internal arrangements of the engine, as to lessen the number of these dreadful accidents, if not altogether to prevent such occurrences from taking place in future. *In a country like yours, where one man's life is just as valuable as any other man's*, this is a matter which requires your serious consideration, and all the ingenuity you possess. You ask the reason why so many workmen lose their lives in this business, but I confess my inability to give you any very definite reply to such a question, not having sufficiently weighed the subject, as yet, in all its bearings. However, my present impression is, that the principal cause of these misfortunes may be ascribed to the circumstance, that the mechanism is so extensive inside as to monopolize nearly all the footing or standing place; and as some parts of the machinery require to be operated by the hand, and others by power, it often occurs that the workman, from inattention, or want of experience, fails in performing his part of the work within the necessary time, and the section on which he stands is the next to be operated upon by the air cylinder, and should he not shift his position before it begins to open its jaws, he is at once let through the *slide*, receiving at the moment of his exit, a knock from a revolving guard or automaton figure, which is placed under the platform of the main pattern-board levers, for the purpose of clearing away obstructions, such as dead bodies, &c.; and as this knock or kick is commonly given on the crown of the head, life, in most cases, becomes extinct instantly.

Now, my dear sir, could you do away with the manual labour, by the substitution of power; or could you make such alterations, that the men would have a sure standing place to work upon; I say, could you make either of these improvements, I am of opinion, *and so is his Highness*, that you would confer a lasting benefit on mankind, at least on those who are called weavers.

You desire me to explain the meaning of the figures 2, 3, 4, 5, 6, and 7, as you say you are not much skilled in the science of hieroglyphics. You will, no doubt, have observed that they are all female musicians. Each of them wears on her cap the symbol of her rank in the band. Perhaps figure 5 is an exception, however; as I am not so certain of her grade. At first sight, I took her to be a pawnbroker's wife, from the fact of her wearing three balls to her horns; but she is so curious altogether in appearance, that I shall not venture to give any other opinion about her, until I hear from our friend Dr. Lepsius, and I intend writing to him on the subject to-morrow. As soon as his answer arrives, I will give you a com-

plete explanation of that figure, I will also write by the same post, to W. C. Taylor, L. L. D., as he, doubtless, knows all about it, having lately turned his attention to these subjects ; and, in the meantime, believe me to be, with permission from his Highness,

Your most obedient servant,

ALEXIS KERSIVENUS,

Civil Engineer, Homeopathic Physician, &c.

P. S. My family are all well. Cleopatra sends you her love, and three embalmed kisses, together with a vial of frankincense ; and hopes soon to

* * * * *

Had some of our modern inventors seen this loom, with its various appurtenances, it might have saved them many an aching head and broken heart ; and, we have no hesitation in saying, that it would have effectually shown them how far they had been anticipated by an unpretending individual who never even so much as thought it worth while to *secure* its benefits to himself by "Letters Patent." Although Arphaxad lived in a period of the world in which, it is generally supposed, men knew comparatively little, still, we think that his specification, as delivered by himself before the Median monarch, is scarcely to be equalled by our greatest scheming-inventors and patent agents of the present day ; and we would recommend it as a model to all those aspiring spirits who *expect* to reach the uppermost step of fame's ladder, or to have a bronze monument (higher than the Colossus at Rhodes) for a head piece to their narrow stripe of territory, after Chaos has spread his dusky pinions around their once ambitious intellects. However, this is none of our business.

The arts of spinning, dyeing, and weaving now spread rapidly over various parts of China, Persia, Hindostan, and Egypt, where they made great progress, extending into Palestine, in the earliest ages of the Jewish dispensation. Indeed, we find from the book of Joshua, that flax was very anciently cultivated even in Palestine ; for Rahab, the harlot of Jericho, concealed the spies under the stalks of flax which she had laid to dry on the house top. Spinning and weaving were also practised in Idumea, the latter forming the subject of a beautiful allusion in the book of Job :

"My days are slighter than the weaver's yarn,
They are finished like the breaking of a thread."

Job, vii chap, 6 ver. (*Wemyss's Trans.*)

There is the same image in Hezekiah's complaint, a passage by the way, which has sadly perplexed commentators, but is at once explained by the custom of the weaver's cutting away the thrums, by which the piece is fastened to the yarn roller in the loom, when his work is completed :

My life is cut off as by the weaver ;
He will sever me from the loom ;
In the course of the day, he will finish my web."
Isaiah xxxviii chap. 12 ver. (*Louth's Trans.*)

From the history of Samson, it is evident that the cultivation of flax, and the arts of spinning and weaving, were practised by the Philistines. But, the Hebrews were essentially an agricultural, and pastoral people, equally averse to commerce and manufacturing industry. Solomon exerted himself to reform the national habits ; he established an emporium at Eziongeber, to open trading communications with the eastern seas, while his connexion with the Tyrians, enabled him to participate in the commerce of the Mediterranean. It appears that he entered into a league with the reigning king of Egypt, to receive linen yarn at a stipulated price, or fixed duty. This early example of a commercial treaty for regulating a tariff of intercourse, is curiously illustrated by the recent discoveries in Egyptian antiquities ; as we find from them, that the Pharaohs had very large spinning establishments, such as we should in the present day call factories of no small magnitude, so that there was not only enough of yarn left for home consumption in the valley of the Nile but also for exportation. Had Solomon resembled some modern statesmen, he would have protected the spinning industry of Judea by laying a prohibitory duty on the import of foreign yarn ; but Solomon was aware that the protection to Hebrew flax-growers and spinners would so enhance the price of yarn to Hebrew weavers, that they could not bring their goods into a foreign market. He did not establish a monopoly, for he saw very clearly that *every monopoly is a great injury* to the many for the benefit of the few, and instead of telling his weavers to look exclusively to the home market, he endeavoured to open for them as many foreign markets as possible.

But, to return to our subject, it appears that one of the most valuable of Arphaxad's inventions, was that of his improved *shuttle* ; for, as we have already stated, that useful implement in weaving, seems to have been entirely unknown to Ghelen ; and, indeed, no great progress could ever have been made without it. Shuttles were

made of two sorts, one for the fly, the other for the hand-loom, and were pointed at both ends in a similar way to those of the present day, that they might more easily pass through the shed, or sheds of the warp, opened for their reception. In spite of all this, however, the English have the hardihood to claim the merit of having invented the fly shuttle, for one *John Kay* of Bury, in the year 1738; and even Mr. Taylor of Dublin, shows his depth of learning in weaving chronology, when he reiterates the silly story which prevails upon the subject among the ignorant, in his "Sketch of the Progress of the Cotton and Woollen Manufactures, &c."

It is narrated that *Arachne*, a woman of Colophon (daughter of *Idmon*, a dyer) was so skilful in working tapestry, that she challenged *Minerva*, the goddess of the art, to a trial of skill. She represented in her designs, the amours of *Jupiter* with *Europa*, *Antiope*, *Leda*, *Asteria*, *Danae*, and *Alemene*; and although it is recorded that her performances were masterly, yet she was defeated by *Minerva*, and hanging herself in despair, was changed into a spider by the goddess. *Ovid* describes the very ungallant use to which *Minerva* applied the shuttle, in her contest with *Arachne*:

"A great fly shuttle in her hand she took,
And more than once *Arachne's* forehead struck;
The unhappy maid, impatient of the wrong,
Her injured person from the breast beam hung."
(O'Doherty's Trans.)

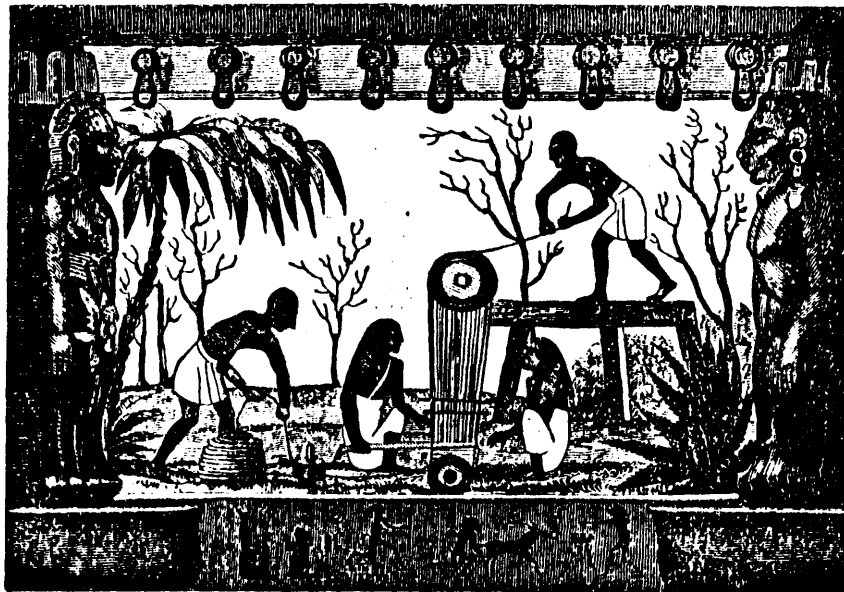
From the delineations existing on Egyptian monuments, weaving was not regarded as a very exhilarating employment: in several instances we can see signs of sadness and melancholy on the countenances of those engaged in the task, reminding us of the sorrow of *Penelope*:

"Full opposite before the folding gate,
The pensive mother sits in humble state;
Lowly she sat, and with dejected view,
The fleecy threads her wary fingers drew."
Odyssey, XVII.

But the sombre aspect of persons thus engaged is easily explained when we remember that most of the female spinners and weavers in Egypt, at the time to which we refer, were captives taken in war, fallen from their former high estate, and forced to bear the contumely of an imperious mistress. It will be remembered with what bitterness of feeling *Hector* forebodes such a fate for his beloved *Andromache*; and, indeed, he had good reason to be sorry for his poor 'gal,' if the labour was as hard in actual practice, as it ap-

pears to be from the annexed illustration ; which is a correct copy of an original drawing taken from the tomb of Hassian ; and we are indebted to the French Consul at Athens, for his great kindness in procuring it for us. It is shown at Fig. E.

Fig. E.



On comparison with Ghelen's loom, it will be observed that in the present drawing, double the number of hands are employed ; and unless these could produce more than twice the quantity of cloth woven in the former, no *saving* would be effected. Perhaps, however, the quality of the fabric was improved by the 'let off' and 'take up' motions, which, no doubt, worked very admirably ; more so, we think, than some of those at present in use ; and we would add, might be advantageously employed on many of our modern carpet power looms.

The scene presented on the border at the bottom of the above drawing, is the pattern at which the weavers are engaged. It is somewhat indistinct, but so far as we can learn, the subject of it is a retreat from a battle-field. The large quadruped towards the right, is a jackass, and the person who holds it by the tail, is its owner, who appears to be one of the vanquished, and is leaving the scene of action with all possible speed, at the same time doing all in his power to save his ass ; but it stands still, either from natural stubbornness, or from fear of one of the victors, who has got in front,

and is endeavouring to catch it, or else to tempt it with a * * *
 * , which he has placed upon a three-legged stool. The man towards the left, who seems to run so fast, is another of the conquerors, and he will, no doubt, soon overtake the ass-driver. He carries, in triumph, upon a pole, the head of some person, whom he has killed in the fight. There is also on the left the figure of a person in a kneeling attitude, who has been taken captive, begging to the leader of the victorious army for his deliverance. The other details which help to compose the design, are merely fragments of the vanquished left on the field, such as coats, pantaloons, vests, helmets, legs, arms, &c.

“Thy woes, Andromache, thy grief I dread,
 I see thee trembling, weeping, captive led;
 In Argive* looms our battles to design,
 And woes of which so large a part was thine.”

(Iliad, vi.)

Homer asserts that the ancients were acquainted with the art of weaving figured patterns of the most splendid kind; and he informs us, that Andromache was engaged in producing a rich flowered pattern when she received the melancholy intelligence of the death of Hector :

“Far in the close recesses of the dome,
 Pensive she ply'd the melancholy loom.
 A gloomy work employ'd her secret hours
 Confus'dly gay with intermingling flowers.”

In the contest between Minerva and Arachne, Ovid gives us the following lively description, dwelling not only on the beauty of the figures which the rivals wove, but also on the delicacy of shading, by which the various colours were made to harmonize together :

“Then both their mantles button'd to their breast,
 Their skilful fingers ply with willing haste,
 And work with pleasure, while they cheer the eye
 With glowing purple of the Tyrian dye :
 Or justly intermixing shades with light,
 Their colourings insensibly unite ;
 As when a shower transpierced with sunny rays,
 Its mighty arch along the heaven displays ;
 From whence a thousand different colours rise,
 Whose fine transition cheat the clearest eyes ;

* Designating what belongs to Argos, the Capital of Argolis in Greece, whose inhabitants were called *Argivi*. This name however is used by the poets for the Greeks in general.—*Paus. Trans.*

So like the intermingled shading seems,
 And only differs in the last extremes.
 Their threads of gold both artfully dispose,
 And, as each part in just proportion rose,
 Some antic fable in their work disclose."

The loom was also used as an embroidering frame, the figures or patterns being worked on the web with small shuttles or circles, as the weaving proceeded, but in some instances the embroidering needle was used instead of the shuttles: these needles were not similar to a common shirt needle, as some of our learned doctors would fain have it, but like those used in the manufacture of Gobelins tapestry; of these we shall have occasion to speak more fully hereafter.

Vests of ornamental work, woven or embroidered, were favourite presents from a fond wife to her husband, from a mother to her son, and from a sister to her brother. Surcoats thus ornamented formed no small part of the warrior's pride. A striking allusion is made to their importance in one of the most glowing passages of Deborah's triumphal hymn. "The mother of Sisera looked out at a window and cried through a lattice, Why is his chariot so long in coming? why tarry the wheels of his chariots? Her wise ladies answered her, Yea, she returned answer to herself, Have they not sped? have they not divided the spoil; to every man a damsel or two; to Sisera a prey of divers colours, a prey of diverse colours of needle-work, of divers colours of needle-work *on both sides*, meet for the necks of them that take the spoil?"

The repetition of "divers colours," in this passage is a strong proof of the value that was anciently set on this species of ornamental work.

It appears from Exodus, chap. xxv. verse 4, that fabrics of blue, purple, fine linen and goats hair, were manufactured to a great extent in Palestine. We read in Exodus, chap. xxvi. verses 1 and 2, "Moreover, thou shalt make the tabernacle with ten curtains of fine twined linen, and blue, and purple, and scarlet: with cherubims of cunning work shalt thou make them. The length of one curtain shall be eight and twenty cubits, (51 ft. 1 inch,) and the breadth of one curtain four cubits: and every one of the curtains shall have one measure." From this we perceive that the web in the reed, or reeds must have stood about 7 feet 3½ inches, which is wider than any plain linen fabrics we manufacture at the present day. The figures of the cherubims must have been woven with shuttles, and very likely as many as a thousand shades of colour

were made use of. Had they been done with the embroidering needle on so very wide a fabric, it would have taken an age at least in its accomplishment. In Exodus, chapter xxviii. verse, 37, we read as follows: "And thou shalt put it on a blue lace, that it may be upon the mitre." See also Exodus, chapter xxxix. verses 21 and 31. From this it is evident that the manufacture of lace was then well understood; and, indeed, it was so long before, in Egypt, as we shall endeavour to show.

We are well aware that in order to manufacture lace, very complex contrivances must be employed, for even with the best Nottingham machinery of our own day *twelve* distinct motions are necessary to complete one mesh.

On referring to the 28th chapter of Exodus, at the 39th verse, we learn how particular were the directions given to Moses regarding the preparation of the sacerdotal robes, to be worn by the high priest: "Thou shalt embroider the coat of fine linen, and thou shalt make the mitre of fine linen, and thou shalt make the girdle of needle-work." The concluding part of this verse shows most decidedly that the principal portion of the fabric was effected by machinery (perhaps like our friend Josué Heilmann's, of Mulhausen, Alsace, France,) otherwise, why should such particular reference be made to the girdles being of needle-work? No doubt, Bezaleel, an ingenious artizan of the tribe of Judah, invented machinery for embroidering those beautiful fabrics very expeditiously: this gentleman also made great improvements on the barrel, and draw looms, the claims of Morton of Kilmarnock, Cross of Paisley, and Bonnar of Dumfermline to the contrary notwithstanding. Aholiab of the tribe of Dan, one of Bezaleel's *particular friends*, made an improvement on one of his (Bezaleel's) machines, which, according to pope Leo X, was named "ogizigo;" this improvement, consisted in substituting vertical wires with hooks or lifters, through which wires, other horizontal ones passed, working through holes in a board, against slips of tin or copper, precisely the same way as in the Jacquard machine. It must be confessed that this is a most remarkable circumstance. These two celebrated workmen (Bezaleel and Aholiab) "were filled with wisdom of heart to work all manner of work of the engraver, and of the cunning workman, and of the embroiderer in blue, and in purple, in scarlet, and in fine linen, and of the weaver; even of them that do any work, and of those that devise cunning work." (Exodus, xxxv. 35.)

Moses also makes mention of the preparation of gold in threads, to be interwoven with the most precious cloths. "They did beat

the gold *into thin plates, and cut it into wires*, to work it in the blue, and in the purple, and in the scarlet, and in the fine linen, with cunning work." (Exodus xxxix. 3.) From this passage it is evident that gold thread, or rather wire, was used in weaving, which thread or wire it also appears, was cut by the aid of a very ingenious contrivance invented by one Zurishaddai, a native of Sidon. We regret that in spite of our endeavours to obtain drawings, or description of this apparatus we have, as yet, been unsuccessful.

We also learn the important fact, that in the times to which we refer, cochineal was known, as well as the mordants, to give brilliancy to the dye; for cochineal being a natural production of the East, it is unreasonable to suppose that its qualities were hidden from the ancients. According to Aristotle, the Chinese made use of it for ages before the Jewish dispensation (Ure's authority to the contrary notwithstanding.)

The cutting of gold into wire, to be woven into cloth, as before observed must have been effected by means of an astonishingly ingenious contrivance, (indeed, it must have been a very shaving machine) because we know from a sample of the cloth which we saw at Rome (in April 1831) that such wire was nearly as fine as No. 205, of our cotton yarn of the present day. While this curious specimen was being exhibited to us we asked the showman, if it was an identical sample of Bezaleel and Aholiab's manufacture, when, with a sarcastic sneer which we shall never forget, he pointed to his Holiness' certificate, affixed to it, remarking, that if heretics wanted any further proofs of its genuineness, they might go to the — himself and enquire!

Homer asserts that the delicate gold net made by Vulcan, the meshes of which were so fine that the gods themselves could not see them, was forged by the Lemnian deity on his anvil. But this assertion of Homer must be a visionary one, or else his godship understood the blacksmithing business much better than most of its professors in the nineteenth century.

" Stung to the soul, indignant, through the skies
To his black forge vindictive Vulcan flies,
Arrived his sinewy arms incessant place
The eternal anvil on the massy base,
A wondrous net he labours, to betray
The wanton lovers as entwin'd they lay,
Indissolubly strong! Then instant bears
To his immortal dome the finish'd snares.

Above, below, around with art bespread
 The sure enclosure folds the genial bed.
 Whose texture e'en the search of gods deceives,
 Thin as the filmy thread the spider weaves."

In the description given by Lucan, of the luxuries with which Cleopatra *allured* Julius Cæsar, it is asserted, that the Egyptians united embroidery with weaving, in the preparation of their richest, and most expensive fabrics :

"In glowing purple rich the coverings lie,
 Twice had they drunk the noblest Tyrian dye,
 Others, as Pharian artists, have the skill
 To mix the party-coloured web at will,
 With winding trails of various silks were made,
 Whose branching gold set off the rich brocade."

(*Pharsalia* X.)

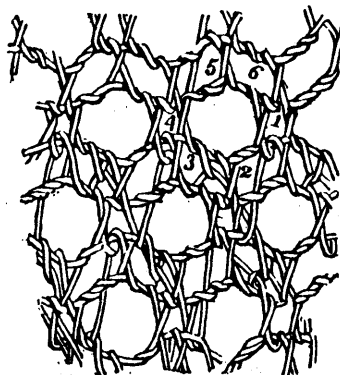
We find that the finest kinds of Egyptian net or cross work makes a very near approach to the modern lace, (see cross weaving.) Indeed, whatever knowledge we possess of lace-making, in any shape, we are indebted for it to eastern genius, and which we think no one will be foolish enough to question, after consulting the proofs we have already given, or shall yet give in the course of this work.

In the prophet's denunciation of Divine vengeance against the land of the Pharoahs, he particularly threatens the *flax, net, and lace manufacturers* : "Moreover, they that work in fine flax, and they that weave net-works shall be confounded." (Isaiah, xix. 9.)

The thin upper dresses worn by Egyptian ladies of *noble descent*, which were so delicate as to be called *woven air*, appear to have been lace of a very fine mesh, (being only 1-16th of an inch in diameter.) Such a dress was by the Hebrews called *shebetz*, and this word is the term by which Solomon describes the vesture worn by Pharoah's daughter : the 45th Psalm, though it has a secondary and more holy signification, being in its primary and literal sense a hymeneal ode on his marriage with that princess. "The king's daughter is all glorious within ; her clothing is of wrought gold ; she shall be brought unto the king in raiment of needle-work, the virgins, her companions that follow her, shall be brought unto thee." (Psalm xlv. 13, 14.)

EGYPTIAN SHEBETZ.

'NET-WORK,' OR 'OPEN-WORK.'



We have, after three years and five months of unceasing research, at last procured the above extraordinary specimen of net-work or lace, known to the ancients by the appellation of 'open-work,' and of which mention is so frequently made in the scriptures. Our drawing was made from a piece of cloth $2\frac{1}{4}$ yards in length, by $45\frac{3}{4}$ inches in breadth, which now forms part of the curious collection of his Highness Mehemet Ali, the present vice-roy of Egypt. We are assured by our friend, the British Consul at Cairo, that its genuineness is unquestionable, and as for the faithfulness of our representation, nothing more need be said, than that he copied it himself from the original, and that too upon exactly the same scale.

The machinery used in the manufacture of this kind of lace must have been astonishingly complicated, for the threads are so miraculously linked, crossed, and twisted together, that we are really surprised that it could ever have been produced at all. There are two kinds of meshes in this sample, the smaller ones, which we have marked 1, 2, 3, 4, 5, and 6, surround one of the large kind, giving it the appearance of a honey comb. This net bears a close resemblance to the Grecian net, but it is on a miniature scale in comparison. In the Grecian, each large mesh is surrounded by ten small ones, so that there is a greater disproportion between the sizes of the meshes than in our specimen. There is little difference in other respects, however.

Through the instrumentality of our old friend, Alexis Kersivenus of Alexandria, we have also received another specimen of Egyp-

ian net, of an entirely different stamp, and which will be described in the part of this work headed "lace manufacture."

The arts which flourished in Egypt previous to the Jewish dispensation, and in which the Pharaohs took so lively an interest, would undoubtedly have reached even a higher state of perfection than they did, had they been allowed to continue under such favourable circumstances; but after the subjugation of the nation by Cambyses, 525 years before our Saviour, the arts and sciences under a foreign yoke, disappeared, or rather ceased to be indigenous in Egypt. The Ptolemies, indeed, encouraged them; but under their reigns the arts were chiefly controlled by Grecians. The Egyptians had degenerated from the knowledge of their ancestors, whose hieroglyphics, they themselves no longer understood.

Among the modern Egyptians, but slight remains or traces of the ancient state of the art of weaving lace, or net-work, are now to be found.

The use of shebetz or net-work, for vests and petticoats, enables us to explain a passage in which several modern versions, including the English authorised version, have gone astray, by supposing that "a net" was used metaphorically for entanglement, and consequent pain. In the description which the young Amalekite gave David of the circumstances attending the death of Saul, he stated, "He said unto me again, stand, I pray thee, upon me, and slay me; for anguish is come upon me, because my life is yet whole in me." (2 Sam. i. 9.) The phrase rendered "anguish is come upon me," literally signifies "this net-work has entangled me," clearly alluding to his coat of mail, which, as we see on the Egyptian monuments, was made of net-work, to the meshes of which, scales of metal about the *size of a dollar* were attached. This circumstance is sufficient proof that the literal interpretation is preferable to the figurative, especially as there is no instance of the word shebetz being used metaphorically in any other part of the Bible.

We shall conclude this part of our subject with Lucan's account of the excellence to which they attained in the preparation of articles of female dress. He thus describes the costume of Cleopatra, when she received Julius Cæsar:

" Amidst the braidings of her flowing hair,
The spoils of Orient rocks and shells appear;
Like midnight stars, ten thousand diamonds deck
The comely rising of her graceful neck;
Of wondrous work a thin transparent lawn
O'er each soft breast in decency was drawn,

Where still by turns the parting threads withdrew,
 And all the panting bosom rose to view.
 Her robe, her every part, her air confess
 The power of female skill exhausted in her dress."

(*Pharsalia X.*)

The Egyptians allowed greater privileges and luxuries to their wives than any other ancient nation. Nothing can exceed the splendour of their queens; thrones were constructed for their peculiar use; even barges, boats, and yawls seem to have been built especially for their service. When we see the magnificence surrounding the Egyptian queens, we can scarcely accuse Shakespeare of exaggeration in his description of Cleopatra's voyage down the Cnydus:

"The barge she sat in, like a burnished throne
 Burn'd on the water; the poop was beaten gold;
 Purple the sails, and so perfumed, that
 The winds were lovesick with them; the oars were silver,
 Which to the tune of flutes kept stroke, and made
 The water which they beat to follow faster,
 As amorous of their strokes. For her own person,
 It beggared all description; she did lie
 In her pavilion (cloth of gold of tissue)
 O'er picturing that Venus, where we see
 The fancy outwork nature: on each side her
 Stood pretty dimpled boys like smiling Cupids,
 With diverse coloured fans, whose wind did seem
 To glow the delicate cheeks which they did cool,
 And what they undid did.
 Her gentlewomen like the Nereides,
 So many mermaids, tended her i'th' eyes,
 And made their bends adornings: at the helm
 A seeming mermaid steers; the silken tackle
 Swell with the touches of those flower soft hands
 That yarely* frame the office. From the barge
 A strange invisible perfume hits the sense
 Of the adjacent wharfs."

Many of the Egyptian painters display considerable talents for caricature in their representations of entertainments. There is one in the British Museum, in which the ladies at a party are depicted discussing the merits of their earrings, and the arrangement of their plaited hair, with an eagerness and rivalry which are highly characteristic. In one or two instances, the ungallant artists have exhibited ladies overcome with wine.

* Dexterously; skillfully; readily.

Though Egypt, as we have shown, made rapid strides in the manufacture of many very beautiful kinds of textile fabrics, yet in the time of Joshua, weaving establishments, on a very extensive scale, were found in the land of Shinar, viz., in the chief city of that district, ancient Babylon; and the machines mostly employed were those invented by E. K. Arphaxad, and which have been already described. "A mantle of Shinar," or as our translators have rendered it, "A Babylonish garment," was secreted by Achan from the spoils of Jericho, and the delinquent speaks of it as the most valuable part of his plunder. Herodotus says, "The Babylonians wear a gown of linen flowing down to the feet; over this an upper woollen garment, and a white tunic covering the whole." Such a dress, particularly if the white tunic were made of woollen, as the venerable historian seems to intimate, must have been too heavy for so warm a climate, particularly in summer, and hence we may be led to suspect that Herodotus included vegetable and animal wool in his description, especially as we know from other authorities, that the cotton manufacture was established in Babylon at a very early period.

From the book of Joshua, as already quoted, we learn that the woven stuffs of Babylon were not confined to domestic use, but were exported into foreign countries. The two chief productions of the Babylonian looms were carpets and shawls; not such as we manufacture in this country, but far superior in design and colouring. Carpets, one of the principal objects of luxury in Asia from the remotest ages, were no where so finely woven, and in such rich colours as at Babylon. We know not when the fashion of spreading them on floors was introduced, but the earliest Greek historians speak of them as commonly used for this purpose in the palaces of kings, and the houses of the wealthy. On the Babylonian carpets were woven, or depicted, representations of those fabulous animals, the dragon, the griffin, the night-mare *in all its varieties*, and other unnatural combinations of form, probably originating in India, with which we have become acquainted by the ruins of Persepolis. It was by means of the Babylonian manufactures, that the knowledge of these fanciful and imaginary beings, was conveyed to the western world, and from them they were transferred to the Greek vases. Foreign nations made use of the Babylonian carpets in the decoration of their *harems* and royal saloons; but no where was this species of luxury carried to such an excess as amongst the ancient Persians. With them not only the floors, but even beds and sofas in the houses of the nobles, were

covered with two or three of these carpets; nay, the oldest of their sacred edifices, the tomb of Cyrus at Pasargada, was ornamented with a purple carpet of Babylonian workmanship. Sir Gardiner Wilkinson, on the authority of Diodorus Siculus, informs us, that carpets were used in Egypt, where they were spread for the sacred animals, and Homer reckons a carpet among the luxuries, with which Menelaus, who visited Egypt, astonished Telemachus, when he received that Prince in the Palace of Sparta :

“The seat of majesty Adraste brings,
With art illustrious for the pomp of kings.
To spread the pall, beneath the regal chair,
Of softest wool, is bright Acclipe's care.”

(*Odyssey, IV.*)

A small piece of carpet, or rug, has lately been brought from Egypt, and is now in the possession of lady Hamilton of Amsterdam. It is fifty-six and a half inches long, and thirty-six broad; and is made, like Brussels carpeting, with woollen warp for the face or pile, and linen twine for the back. In the middle is the figure of a fox in scarlet, with a night-owl above it, the hieroglyphic of a ‘rogue,’ upon an orange ground; around which is a border composed of blue and purple lines; the remainder is a ground of light pink, with violet figures of the pelican and curlew above and below, and on each side crimson outlines with bright yellow ornaments; and the outer borders are made up of white, blue, and green lines about $\frac{3}{8}$ ths of an inch wide, each line having fancy devices projecting from it, with a triangular summit which extends entirely round the edge of the carpet.

Sir Gardiner Wilkinson, also gives us an account of a small carpet rug of Egyptian manufacture, which he says is now in the possession of a Mr. Hays. It does not differ very materially from the one just noticed. “This rug,” says Sir G. W., is eleven inches long, by nine broad. It is made, like many carpets of the present day, with woollen threads on linen strings. In the centre is the figure of a boy in white, with a goose above, the hieroglyphic of a ‘child,’ upon a green ground; around which, is a border composed of red and blue lines; the rest is a ground of yellow, with four white figures above and below, and on each side are blue outlines with red ornaments; the outer border being made up of red, white, and blue lines, with a fancy device projecting from it, having a triangular summit, which extends round the edge of the rug. Its date is uncertain; but from the child, the combination of the

colours, and the ornament of the border, I am inclined to think it really Egyptian."

The Babylonian shawls, like those of Persia, were adorned both with gold and variously coloured figures. Hence, Publius Syrus compared a peacock's tail, to a figured Babylonian mantle enriched with gold. Their magnificent appearance, and exquisite texture, are celebrated both by the Greek and Roman writers. It was always deemed to be one of the most singular displays of ascetism in the elder Cato, that he immediately gave away a splendid Babylonian shawl, which some foreign potentate had bequeathed to him, as a remuneration for political services.

Next to the carpets and shawls, the Babylonian garments called *Sindones* were held in the highest estimation. From the descriptions given of them, it would appear that they were in all probability a cotton fabric, though some may have occasionally been made of linen; for we find from the Levitical law, that linen had some religious significance. The most costly *Sindones*, were so highly valued for their fineness of texture, and brilliancy of colour, as to be compared to those of Media, and set apart for royal use; they were even to be found at the tomb of Cyrus, which was profusely decorated with every species of furniture in use among the Persian monarchs during their lives. The superiority of the textile fabrics of Babylonia, must be ascribed to their spirit of commercial freedom. We do not find in their history, so long as they remained a commercial and manufacturing people, any proof that they ever imposed restrictions upon the import of the raw material of manufactures, or that which may be called the raw material of operatives, namely, *human food*. When the barbarous Chaldeans conquered the country and introduced the spirit of monopoly, the commercial spirit of Babylonia was cankered at the root, and its pre-eminence destroyed.

The Tyrians are chiefly known to us in commercial history for their skill in dyeing; the Tyrian purple formed one of the most general and principal articles of luxury in antiquity: but dyeing could scarcely have existed without weaving. Homer, for instance, when Hecuba, on the recommendation of the heroic Hector, resolves to make a rich offering to Minerva, describes her as selecting one of Sidonian manufacture as the finest which could be obtained.

" The Phrygian queen to her rich wardrobe went
Where treasured odours breathed a costly scent;
There lay the vestures of no vulgar art—
Sidonian maids embroider'd every part,

Whom from soft Sidon youthful Paris bore
 With Helen, touching on the Tyrian shore.
 Here, as the queen revolved with careful eyes
 The various textures and the various dyes,
 She chose a veil that shone superior far,
 And glow'd refulgent as the morning star."

(*Iliad*, VI.)

From the interesting history of his adventures, which Eumeus gives to Ulysses, we learn that Phenician women, on account of their skill in weaving, were frequently kidnapped by the pirates of the Levant, and sold in the Greek islands.

"Freighted it seems with toys of every sort
 A ship of Sidon anchor'd in our port ;
 What time it chanced the palace entertain'd,
 Skill'd in rich works, a woman of their land ;
 This nymph, where anchor'd the Phenician train,
 To wash her robes descending to the main,
 A smooth-tongued sailor won her to his mind,
 (For love deceives the best of woman kind)
 A sudden trust from sudden liking grew—
 She told her name, her race, and all she knew.
 'I too,' she cried, 'from glorious Sidon came,
 My father, Arybas, of wealthy fame ;
 But snatch'd by pirates from my native place
 The Taphians sold me to this man's embrace.'"

(*Odyssey*, XV.)

Among the ancients, the husband purchased his wife by money or personal services. The Assyrians put the marriageable women up at auction, and the price obtained for the more beautiful was assigned as a dowry to the more homely. (See Tytler's *Ancient History*, page 18.) This plan (for anything we see to the contrary,) might work well in this country, even at the present time.

Heeren has very ably shown the circumstances which tended to foster and develop the woollen manufactures of Tyre, in his admirable "Researches into the Politics and Trade of Ancient Nations."

"The wool of the wilderness," says this able writer, "was one of the wares supplied by the pastoral tribes, who wandered with their flocks, as well over the Syrian, as over the Arabian deserts.* The fleece of their sheep is the finest known ; it is improved by the heat of the climate, the continual exposure to the open air, and the care that these people bestow upon their flocks, which constitute their

* Ezekiel, xxvii, 18—21.

only business, all of which help to render it more precious.* The Arabian sheep, distinguished from the European by their immense tails, were known to Herodotus, who has left us a description of them.† “Arabia likewise possesses two extraordinary breeds of sheep, neither of which is found elsewhere. One of these has long tails, not less than three cubits; and, were they suffered to drag behind them, they would become sore by rubbing against the ground. The shepherds therefore, make small carriages, and fasten them under their tails, to each animal one. The other kind of sheep have broad tails, each an ell in width.”

Herodotus only errs in taking a mere variety for a distinct species; all the other circumstances he here mentions, are known to modern naturalists and travellers. A moment's reflection upon Tyrian manufactures of woven goods and their dyes, will enable the reader at once to perceive the great importance of this branch of commerce. It converted the very wilderness, so far as they were concerned, into an opulent country, which afforded them the finest and most precious raw materials, for their principal manufactures. This circumstance, too, was a means of cementing and preserving a good understanding between them, and those nomad tribes; a matter of no inconsiderable importance to the Phenicians, as it was through the nomads, that the rich produce of the southern regions came into their hands.

One great source of the manufacturing prosperity of Tyre was the *absence of restrictions* on the importation of human food. The twenty-seventh chapter of Ezekiel, which Michaelis justly describes as the most ancient monument of commercial history, informs us, that Palestine was the granary of the Phenicians. Their own mountainous territory was but little adapted for agriculture, and they were too wise to force unproductive soils into cultivation by bounties and protective duties; Palestine, their commercial ally, produced corn in sufficient abundance, to be able to supply themselves plentifully, with this first necessary of life. This is expressly declared by the prophet: “Judah and the land of Israel, they were thy merchants; they traded in thy market wheat of Minnith, and Pannag, and honey, and oil, and balm.” (Ezekiel, xxvii. 17.) Heeren has very properly called attention to the marked effect of this commercial intercourse, in preserving the harmony of the two

* See Michaelis on the Wandering Shepherds, in his *Vermischten Schriften*, b. i. s. 6.

† Herod, iii. 113.

nations ; it is, indeed, a memorable example of freedom of trade, becoming the very bond of peace.

The fact that Palestine was the granary of the Phenicians, explains in the clearest manner, the good understanding, and lasting peace that prevailed between these two nations. It is a striking feature in the Jewish history, that with all other nations around them, they lived in a state of almost continual warfare ; and that under David and Solomon, they even became conquerors, and subdued considerable countries, and yet with their nearest neighbours, the Phenicians, they never engaged in hostilities. But if a sense of their weakness prevented them from attacking these mighty cities, the natural policy of the Phenicians, no less on the other hand, restrained from any hostile attempt on a country from which they drew their subsistence : to which it may be added, that it seems to have been a maxim among them to avoid all wars and forcible extension of their dominion over the continent of Asia.

We learn from Ezekiel, that although the Phenicians were manufacturers themselves, they freely imported textile fabrics from other countries. " Fine linen with brodered work from Egypt was that which thou spreadest forth to be thy sail ; purple and scarlet from the isles of Elishah, was that which covered thee." (Ezekiel, xxvii. 7.) The Egyptian manufacturers have been already mentioned ; " the isles of Elishah ?" is a name given to the islands, and southern peninsula of Greece, and this name was for many centuries perpetuated in that part of the Peloponnesus called Elis. This passage affords another singular proof, of the freedom of commerce established among the Tyrians ; for, though dyeing in purple was one of the staple branches of their national industry, we find them freely importing purple stuffs from the Peloponnesus.

Only vague and uncertain traditions or allusions in the ancient poets, give us any information respecting the progress of textile industry in Asia Minor, the Ionian colonies, and the islands of the Egean. Homer, as we have already seen, represents the Trojan ladies as peculiarly devoted to the spindle and loom ; and Theocritus in his exquisite Eighteenth Idyll, the Epithalamium of Helen, introduces the Trojan ladies celebrating the skill of Helen in weaving, as not less worthy of praise than her unrivalled charms.

" When winter thus in night no longer lours
And spring is usher'd by the blooming hours,
The rising morning, with her radiant eyes,
Salutes the world, and brightens all the skies ;

So shines fair Helen, by the Graces drest,
 In face, shape, size, superior to the rest:
 As corn the fields, as pines the gardens grace,
 As steeds of Thessaly the chariot race;
 So Helen's beauties bright encomiums claim,
 And beam forth honour on the Spartan name.
 What nymph can rival Helen at the loom,
 And make fair art like living nature bloom?
 The blended tints, in sweet proportion join'd,
 Express the soft ideas of her mind."

(*Idyll, XVIII.*)

Both Horace and Virgil have celebrated the fine woollen cloths of Miletus, which were held in high esteem by the Roman ladies.

In another *Idyll*, Theocritus incidentally notices the great superiority in the textile manufacture of the Greeks, who had settled in the eastern countries, over those who had colonized Sicily and Southern Italy: we allude to the very amusing record of the gossip between two Syracusan ladies, who had come to Alexandria for the purpose of witnessing the magnificent shows and solemnities, prepared by Arsinoe, the queen of Ptolemy Philadelphus, to celebrate the feast of Adonis, revived under her auspices. Nothing seems to have excited the wonder of their fair ladies more than the magnificent tapestries which adorned the Greco-Egyptian palace of the Ptolemies, and they express their astonishment very naturally after having elbowed their way through the crowd.

PRAXINOE.

"See how the folks, poor Erinoe, jostle!
 Push through the crowd, girl!—bustle, bustle!
 Now we're all in.

GORGO.

Lo! what rich hangings grace the rooms!—
 Sure they were wrought in heavenly looms!

PRAXINOE.

Gracious! how delicately fine
 The work! how noble the design!
 How true, how happy is the draught!
 The figures seem inform'd with thought—
 No artist sure the story wove—
 They're real men,—they live, they move.
 From these amazing works we find
 How great, how wise the human mind!
 Lo! stretch'd upon a silver bed,
 (Scarce has the down his cheeks o'erspread)

Adonis lies! O charming show!
Loved by the sable powers below!

STRANGER.

Hist! your Sicilian prate forbear,
Your mouths extend from ear to ear;
Like turtles that for ever moan
You stun us with your rustic tone.

GONGO.

Sure! we may speak! What fellow's this?
And do you take it, sir, amiss?
Go, keep Egyptian slaves in awe;
Think not to give Sicilians law."

(*Idyll, XV.*)

There is not a little humour in the gossiping, gadabout Syracusan ladies, thus unceremoniously branding the Greek ladies of Egypt as slaves, because they stayed at home to attend to the labours of the spindle and shuttle, instead of running about the streets to see the gorgeous spectacles of the festival, like many *worthless flirts* of our own day. The poet in several other passages, refers to the domestic industry of the Asiatic Greeks, so different from the indolence of the fair Sicilians.

The island of Cos very early enjoyed a high reputation for its textile fabrics, and their excellent purple dyes. In the age of Augustus they were esteemed the most becoming ornaments to ladies, *anxious to direct attention to their charms*. Hence Horace, reproaching Lyce, says,

"Not Coan purple, nor the blaze
Of jewels, can restore the days,—
To thee, those days of glory,
Which wafted on the wings of time,
E'en from thy birth to beauty's prime
Recorded stand in story."

(*Book IV. Ode XIII.*)

From the description which Horace gives of the Coan robes in the second satire of his first book, and from the parallel passages in contemporary poets, we learn that the Coan robe had a great degree of transparency, that it was remarkably fine, that it was chiefly worn by women of light character, (nymphs of the pave) that it was usually dyed purple, and sometimes enriched with stripes of gold. It is by some writers supposed to have been made of silk, because, as we learn from Aristotle, silk was at a very early period spun and woven in Cos, and was the chief cause of the high ce-

lebrity attained by the manufactures of that island. Hence Tibullus promises his mistress,

“ Since beauty sighs for spoil, for spoil I'll fight !
 In all my plunder Nemesis shall shine.
 Yours be the profit ; be the peril mine.
 To deck your heavenly charms the silkworm dies,
 Embroidery labours, and the shuttle flies.”

(*Eleg. ii. 6.*)

In a painting discovered at Pompeii, there is a representation of a lady weaving a tunic of almost perfect transparency, which may probably have been a Coan vest ; but, so far as we are enabled to judge from such imperfect evidence, we should believe it to be a thin muslin. Pliny, however, distinctly asserts, that the Coan dresses were made of silk. “ The Grecian women,” he says, “ unravel the silks imported from Asia, and then weave them anew, whence that fine tissue, of which frequent mention is made in the Roman poets under the name of *Coan vests*.” Salmasius has shown, that Pliny in this case misunderstood the passage of Aristotle's Natural History, to which he referred. The Greek means nothing more than “ females wind off the web of the silk worm, and then weave the threads,” not as Pliny would interpret it, “ unravel the texture of the dress and then weave it over again.”

The practice of weaving in the island of Scycos, is proved by the description which the poets have given of the occupations of Achilles, when concealed there in a female dress. This tale is prettily told by Moschus :—

“ In close disguise his life Achilles led
 Among the daughters of king Lycomed :
 Instead of arms the hero learn'd to cull
 The snowy fleece, and weave the twisted wool.
 Like theirs, his cheeks a rosy bloom display'd ;
 Like them, he seem'd a fair and lovely maid ;
 As soft his air, as delicate his tread ;
 Like them, he cover'd with a veil his head.”

(*Idyll, VII.*)

It is obvious that with such a piece of mechanism as Arphaxad's vertical loom, and the use of several colours, splendid patterns could be produced. Those fabrics “ of many colours” were highly valued as dresses in patriarchal ages, and, indeed, have always been regarded in the East as symbols of rank and distinction. Hence we may explain the cause of jealousy to which Joseph was exposed when Jacob presented him with a dress superior to those worn by

his brethren. According to Pope Leo X, this dress was woven by Arphaxad's power loom, in the city of Ninevah. The sacred historian relates, "Now Israel loved Joseph more than all his children, because he was the son of his old age: and he made him a coat of many colours. And when his brethren saw, that their father loved him more than all his brethren, they hated him, and could not speak peaceably unto him." (Gen. xxxvii. 3, 4.) Their envy was excited not only by the superior beauty of his dress, but by his father's having apparently invested him with some special dignity or authority over his brethren, of which the ornamental garment was the outward sign. Even at this day Eastern potentates, when they confer office upon a favourite, present him with a *khelat*, or dress of honour, as a symbol of the rank to which he has been elevated. It appears that the statement made by his Holiness (Leo X.) about Joseph's coat cannot be relied upon as being correct, as we find it recorded by Basharaboo, a Persian author, that Jacob obtained the cloth "of many colours" from the city of Babylon.

Lesbos was also remarkable for the practice of weaving as an important branch of domestic industry. Among the fragments of Sappho, we find part of an ode addressed by the poetess to her mother, as an apology for neglecting the labours of the loom:

"Cease, gentle mother, cease your sharp reproof,
My hands no more can ply the curious woof;
While on my mind the flames of Cupid prey,
And lovely Phaon steals my soul away."

(Frag. IV.)

The fable of Hercules and Omphale proves that textile manufactures were very early established in Lydia; they were patronized by the kings of the successive dynasties; and some of the spinning and weaving establishments were so extensive as to deserve the name of factories. Lydian and Phrygian dresses were largely imported into Italy in the reign of the Cæsars; St. Luke mentions their traffic in purple dyes, in the acts of the Apostles. Attalus, one of the petty sovereigns of Asia Minor, is honourably mentioned by Pliny as a monarch who zealously exerted himself to promote manufacturing industry among his subjects; he introduced the manufacture of gold tissue into his little principality of Pergamus with so much success, that this species of luxurious cloth retained the name of Attalic to the later ages of the Roman empire. In the western world Carthage appears to have been the principal seat of manufacturing industry, as it unquestionably was of commercial enterprise. Its *carpets and shawls* were particularly celebrated,

and appear to have brought as high a price as those of Lydia. An entire book was written by *Polemo* "Concerning the shawls of Carthage." But from the time that the fatal ambition of the Barchine family changed Carthage from a commercial to a belligerent state, its textile establishments seem to have declined, for only faint traces of their existence can be found in Roman writers.

The weaving establishments of the Medes and Persians were very extensive, and Persian carpets had as high a name in ancient times as at the present day.

Of the manufactures of India we can convey to our readers no better idea, than by giving Dr. F. Buchanan's description of them, which we copy from his second volume of a manuscript account of Behar and Patna, preserved in the library of the honourable East India Company.

"A great deal of the cotton is freed from the seed by the women who spin it, and a part of this is also beaten by the same persons; but the Dhuniyas, who make a profession of cleaning and beating cotton, separate the seed from some, and beat the greater part. Perhaps one third of them have stock enough to enable them to buy a little cotton, which they clean and then retail; the remainder work entirely for hire. A man and his wife can make from three to four rupees a month. In country places they are often paid in grain. At Arwál they are allowed $1\frac{1}{2}$ sers of grain for beating one ser of cotton; and in one day a man beats four sers (45 S. W.) equal to about $4\frac{1}{2}$ lbs., and of course receives $6\frac{1}{2}$ lbs. of grain. Those who have a little capital may make 4 or 5 rupees a month.

"In every division I procured an estimate of the proportion of women who spin cotton, of the average quantity of cotton that each spins, and of the value of the thread. Such estimates are liable to numerous objections; but it is probable when a number of them are taken, that the errors of the one will be nearly corrected by those of the others, so that the average will not be far from the truth. Allowing that the women of an age fit to spin are one-fifth of the population, the estimates that I procured will give for the whole thus employed 330,426 spinners. Now by far the greater part of these spin only a few hours in the afternoon; and, upon the average estimate, the whole value of the thread that each spins in the year is worth nearly 7R. 2A. 8P., giving for the total annual value 2,367,277 rupees; and by a similar average calculation, the raw material, at the retail price will amount to 1,286,272 rupees, leaving a profit of 1,081,005 rupees for the spinners, or $3\frac{1}{2}$ rupees for each. But there are many women who spin assiduously, and who have no interruptions from

husband or children, and these make much more, especially where the thread is fine ; there being no sort of comparison between the reward allowed for such, and that given to those who spin coarse thread. As the demand, therefore, for fine goods has been for some years constantly diminishing, the women have suffered very much. Another calculation agrees so well with the above that I have little doubt of the general accuracy of both. An estimate was made in each of the divisions of the number of looms employed, of the quantity and value of thread required annually for each, if employed in working at the usual rate, and the most usual kind of goods, and the following is the result :

	Rupees.
Cotton thread required for cotton cloths, - - - - -	2,229,979
do. for mixed cloths, - - - - -	101,762
do. for tape, carpets, tent-ropes, &c., - - - - -	37,125
do. for sewing thread, &c., - - - - -	2,000
	2,370,866

“Some thread is both exported and imported. Taking the amount of the statements, the excess of that imported will be worth 30,500 rupees, which could reduce the demand on the thread of this district to about 2,340,356 rupees in place of 2,367,277 rupees, which I have allowed to be spun ; but, at Bhagalpur, it was said that 1,450 rupees worth of thread was there imported from Patna ; and at Puraniya there is imported to the value of 12,000 rupees, of which a half comes probably from the same town, while the merchants here only allowed an export of 3,420 rupees.

“The whole thread is spun on the small wheel common in India, and the implements for cleaning and beating the cotton are not different from those that are usual. No rank is considered here as degraded by spinning.

“The cotton weavers are numerous. Those of Phatuha are employed in weaving cotton diaper, (khés,) which the natives use as a dress ; but the great demand is for Europeans, who use the manufacture for table linen. By far the greater proportion of the cotton weavers is employed in making coarse cloths for country use, but a good many make finer goods for exportation. The amount of thread required is 1,771,379 rupees, and the value of the cloth 2,438,621 rupees, leaving a profit of 667,232 rupees, or 28½ rupees for each loom. It may be supposed that the finer qualities of goods taken for exportation would diminish the value of the raw material, and increase the total value of the commodity, but that would not appear to be the case. Although the quantity of thread is no doubt

less, yet as the reward for spinning the fine is much higher than that for spinning the coarse, the actual value is perhaps a little higher than I have stated, and may reduce the average profit to 28 rupees a year for each loom. Each man on becoming bound (asami) to the Company receives 2 rupees, and engages not to work for any person until he has made as much as the Company requires; no other advance has ever been made by the commercial residents. The agent orders each man to make a certain number of pieces of such or such goods, and he is paid for each on delivery according to the price stated in the tables. This shows clearly that the system of advance is totally unnecessary; but it is here pursued by all the native dealers, as keeping the workmen in a state of dependence, little better, if so good, as slavery.

"The loom is of the imperfect structure usual in India; and where starch is used to facilitate the working, it is made from the root called kandri. It must be observed that all the Indian weavers who work for common sale, make the woof of one end of the cloth coarser than that of the other, and attempt to sell it to the unwary by the fine end, although every one almost who deals with them is perfectly aware of the circumstance, and although in the course of his life any weaver may not ever have an opportunity of gaining by this means. The same desire of illicit gain induces him almost universally to make the pieces somewhat shorter than the regular length.

"The coarser goods intended for market sale are always sold as they come from the loom, but those intended for private sale are all bleached, and many of them undergo operations by different classes of tradesmen. It must be observed that in this district the weavers were bound to act as porters for conveying the goods of travellers; and when any person of rank or authority calls upon the zemindar for such, the weavers are still required to perform this office. On some estates they are, on this account, allowed an exemption from ground-rent for their houses; on others they are taxed at a higher than usual rate.

"At Behar, a class of artists called parchahkush is employed to put all the threads in the bleached cloth at equal distances. (See the drawing marked Fig. A, of Arkite Ghiden Ghelen's loom, where this delicate operation is being effected by the female figure in front.) The cloth made there being very thin, the operation of bleaching brings the threads into clusters, leaving many parts almost in holes. These workmen place all the threads at equal distances with a wooden comb. In some other places a needle is used. Many fine

pieces of cloth are ornamented at the ends with the flattened gold and silver wire called *bad-la*, which, as the natives use the pieces entire, looks very showy. It is not woven into the cloth, but put in with a needle.

"In each piece of the muslins of Behar, the pieces of which are two cubits wide, the workmen who perform this operation stitch from 5 to 7 bands of this *bad-la*, each consisting of 350 wires. The workmen receive 4 anas for the 100; and a man can daily put in from 50 to 70. Allow that he puts in 60, and works 26 days a-month, he will receive about 4 rupees, (3 $\frac{2}{3}$); and 32,000 cubits of the wire costing one rupee, he has about 3 $\frac{7}{8}$ rupees a-month for profit.

"The Chhapagars put gold and silver flowers on fine muslin by a very simple process. They stamp the cloth in the form wished with common glue, and then apply gold and silver leaf, which adheres to the glue, but rubs off where that has not been applied. Of course this cloth cannot be washed, but is very showy, and used only on high occasions.

"All the blanket weavers are shepherds."

The progress of weaving in Greece seems to have been slow; at least those fabrics of the finest description, were imported from Asia, during the classic ages, at a cheaper rate than they could be produced in Greece.

There were, however, several large manufactories for the weaving of *pallia*, a word which might be more properly translated *blankets* than cloaks. They were indeed, sometimes coloured, but in these cases the wool was dyed in its raw state, and the palls were worn in the very form in which they were taken from the loom.

They were rectangular pieces of cloth, and were used indifferently for cloaks by day and for coverlets by night; we find them also employed as horse-cloths, and even as carpets. Thus in St. Luke's description of Christ's triumphant entry into Jerusalem, we read that the disciples "cast their garments upon the colt, and they set Jesus thereon: and as he went, they spread their clothes in the way:" (Luke xix. 35, 36.) This was an oriental form of recognizing Jesus as king, and it is still observed in many eastern countries, during the royal progresses of their monarchs. The cumbrous palls were occasionally laid aside when any work was to be done requiring great exertion. Thus we read in the Acts of the Apostles, that those who went to stone the Proto-martyr Stephen, "laid down their cloaks at the feet of Saul." (Acts, vii. 58.)

Thus also Telemachus, when attempting to bend the bow of Ulysses,

“ His girdle loosed, his glittering sword unbound,
And cast his purple mantle on the ground.”
(*Odyssey*, XXII.)

Sometimes, however, the *pall* was gathered close round the body, leaving the upper part of the frame naked; a custom to which the phrase, making “bare the arm,” of such frequent occurrence in the Old Testament obviously alludes. In a favourite old hymn we find,

“ Make bare thine arm, great King of kings,
Thine arm alone salvation brings.

There were many establishments for the weaving of blankets and palls both in Greece and Italy; but particularly in Megara, where the manufacture of coarse blankets formed the staple trade of the country. The work was performed by slaves, who wrought in factories, the spinning being usually done by females, and the weaving by males. Several factories of the same kind were established in Italy, but their productions were chiefly used by the working classes; persons of superior rank either used dresses imported from the East, or those which were wrought in their own household.

We must regard the spinning and weaving of Greece and Italy as a purely domestic manufacture; indeed, every considerable house, especially in the rural districts, had its spinning and weaving rooms, with all the apparatus necessary for the manufacture both of flax and wool. Thus Virgil in his description of rural employments during winter, says,

“ The wife and husband equally conspire
To work by night, and make the winter fire:
He sharpens torches in the glimmering room,
She shoots the *flying* shuttle through the loom.”
(*Georgic*, I.)

No doubt the “flying shuttle” here referred to, is the same as that, the invention of which is claimed by the English, for their countryman, one John Kay of Bury.

In most of the old Grecian and Roman looms the process of weaving was downwards, and the weft was driven home by an instrument called a *spatha*, which was similar to a wooden sword. In later times the *spatha* was superseded by a comb, and this is

the instrument now used by the Hindoos. In our looms the process is effected by the *reed* and *batten*.

The Romans kept their warp yarns parallel by rolling them carefully on a cylinder, which unwound and gave out yarn as it was wanted; a process which in modern manufactures is called "beaming the web," while the Northern nations were forced to pass the threads of the warp over a transverse rod or plank, and then dividing them into thirty or forty parcels, to attach a stone or some heavy weight to each parcel, for the purpose of keeping the warp yarns in their perpendicular direction, and allowing free play for the stroke of the *spatha*.

THE ART OF WEAVING.

"The art of weaving is exceeding old,
As we by king Deioeces have been told.
'Tis said that *Ghelen* weaving first began;
Which hath descended since from man to man.
The mothers taught their daughters, sires their sons,
Thus in a line successively it runs
For general profit, and for recreation,
From generation unto generation.

"Arphaxad was a weaver of great skill;
His four web engines make us wonder still;
For they do art, so like to nature, frame,
As if it were her sister or the same.
Flowers, plants, and fishes, beasts, birds, flies, and bees,
Hills, dales, plains, pastures, skies, seas, rivers, trees;
There's nothing near at hand, or farthest sought;
But with these famous air looms may be wrought.
In cloths of Babylon I've often seen
Men's figured counterfeits so like have been,
That if the party's self had been in place,
Yet art would vie with nature for the grace.
Moreover, poesies, rare anagrams,
Signifique, searching sentences from names,
True history, or various pleasant fiction,
In sundry colours, mix'd with arts' commixion;
In all dimensions, curves, squares, ovals, rounds,
Art's life included within nature's bounds;
So that art seemeth merely natural,
In forming shapes so geometrical."

The art of weaving was unknown in Great Britain previous to the Roman Invasion. After the Romans had obtained a footing in that country, they established a woollen manufactory at Winchester, for clothing their army; and they also taught the benighted

natives the art of weaving, and the culture of flax. The Saxons afterwards introduced several kinds of fabrics for domestic purposes, among which are said to have been *knotted counterpanes with network borders*, for bed-covers, petticoats, pantalets, &c. In the early part of the fourteenth century (1327) Nicholas Grattan, Ned O'Neal, Brien Gallagher, and Jack R. Newbury introduced the manufacture of broad cloth, which manufacture was afterwards protected and encouraged by king Edward 3d, and this fabric has ever since been a staple article of export.

These inventions and discoveries, together with the improvements in calico printing, the discharging of colours, (particularly of Turkey red, for Bandannas) the application of steam, as a moving power, in weaving plain cloth, and innumerable other mechanical inventions, which it would be tedious even to name; these have, within the last fifty years raised the cotton manufacture to a state of perfection, which has no parallel in the history of the arts.

It will be remembered by the reader, that Mr. Kersivenus, in his letter of 23d April, 1843, (given at page 34,) promised us some further information relative to the subjects there spoken about: and after some unavoidable delay, this gentleman has at length written another letter to us, of which the following is a correct translation. No doubt his document will be interesting to many weavers and manufacturers in this country.

Alexandria, 17th Sept. 1843.

Dear Friend:

Your letters of 9th July and 15th August came to hand, and their contents I have just been considering with the greatest attention.

I am happy to hear in the first place, of the safe arrival at the City of New York, of the letter which I had the pleasure of writing you on the 23d of April last. I regret exceedingly not having been able to give you more correct information, on the subject to which you most particularly refer; but this delay has been altogether occasioned by the negligence of Messrs. Lepsius and Taylor, in not answering my letters to them, of 24th April.

For the last fortnight my life has been a burthen to me, as I have been suffering from a sore disease, which *quack doctors* generally call *delirium tremens*. I subjected myself to homeopathic treatment, however, about ten days ago, and am now so far recovered as to be able to keep the children in order, although I cannot yet undertake any *professional duties*.

On examining various letters and other documents, received by this morning's mail, I was extremely delighted to see a communication in the handwriting of our old friend Lepsius, enclosing, also, another from Mr. Taylor. These documents, although certainly not so satisfactory as I could wish, contain, nevertheless, various observations relative to Arphaxad's inventions, which may, to some extent, answer your enquiries; and I shall now submit to you the substance of what they state as briefly as possible.

Figure No. 5, in the drawings, puzzles both the Doctor and Mr. T., and they frankly confess, that they neither know what kind of a character she is, nor yet the object for which she is represented at all. Mr. T., however, suggests from the implements which she carries, that she is a person perfectly skilled in the arts of spinning and figured weaving. Figure No. 8, is a portrait of the prince of weavers, no less than E. K. Arphaxad himself; but this, I think, you might have seen yourself, without any explanation. The fragments of machinery, and other articles scattered over the drawing, according to Lepsius, originally constituted part of the interior mechanism of the engine; but have been thrown into their present state of confusion by a dreadful explosion of the principal air cistern, killing, instantaneously, two beautiful ladies, who were mere spectators, come to the factory, for the purpose of examining some new patterns of shawls, lace, and quilting stuffs, for their wedding dresses. It is somewhat singular that this frightful catastrophe should have happened on a *Sunday*; which circumstance is another proof of the bad effects of working on that day.

You will perceive in the drawing, the wreck of many valuable contrivances used by weavers. Among those may be traced part of Lemuel P. Arybas' nipper or jaw temple, Arphaxad's tappet wheel, fork and grid stop-thread motion, measuring rollers for regulating the giving out of yarn from warp beams by means of endless screws, &c., lace and embroidering machinery of various kinds, cams and cam-wheels, with a variety of spinning apparatus, which, to all appearance, judging from the figures, is at least equal to the best spinning machinery of the present day.

From these remains it would seem that Arphaxad's loom was capable of producing various textures at one and the same operation. Indeed, Lepsius informs me that Arphaxad constructed a machine for Gengis-Khan, adapted to weave 30 pieces of cloth at once, these pieces varying in width from 25 to 74 inches, and forming the most beautiful textures and patterns imaginable; surpassing in splendour of appearance even the most gorgeous tail of the peacock, and dis-

playing a greater variety of colouring than that proud bird can boast of. This machine, although containing so many webs, and working so many shuttles (averaging 30 shuttles to each of the 30 webs, or 900 in all) appears to have cost only 1 *shekel* of silver per diem for the necessary driving power. The proprietor, therefore, must have realized a handsome profit while the engine was in successful operation, in as much as it turned off 1200 yards daily, of perfect goods, with the assistance of a mere child to superintend it. The average price at which the cloth was sold per yard, taking one web with another, was about 75*l.*; and the cost of the raw material was not over 30 per cent of that sum, the cloth being extremely light, owing to the astonishing fineness of the thread used. The original cost of the machine, however, formed an important item, as it was not less than 140,000*l.* of your money. Lepsius is unable to say whether this enterprise turned out a good speculation for Gengis-Khan, or not, as he cannot ascertain how long the loom was in operation before it *blew up*.

From these *facts* we may take it for granted, that the fragments shown in the drawing *did* actually form part of the mechanism of the engine represented, previous to the explosion of the air cistern; the spinning machinery, no doubt, being employed in furnishing the different warps and wefts as required. Whether the thread used was of gold or silver, neither the Doctor or Mr. Taylor is able to say; but, in my opinion, gold was the material used, to which the necessary endless variety of shades had been previously given by some highly ingenious chemical process. Had the thread not been of gold, the textures could not have been so expensive.

The specimen of cloth in possession of his Highness, and of which I spoke to you in a former letter, although 5,331 years old, yet it is beautiful beyond conception—*as fresh and perfect as if finished yesterday*. This specimen contains 130 shades of colour, and is of pure gold. I shall forward you in a few days 11½ inches of it, which I have procured from his Highness at an expense of 90 shekels of gold. The pieces of glass cloth which you had the kindness to send me, are not to be compared to it in richness of colouring and design.

Regarding the spinning engine of Wallotty Trot, the Doctor thinks it did not differ materially from that demolished by the explosion, part of which is shown at No. 9.: but whether Trot used rollers, as at No. 10., or flyers, as at No. 11., neither Lepsius nor Taylor can decide.

Since writing the above, my son has found another paper, among

those brought this morning, from Doctor Lepsius, who has elicited some further ideas relative to the figures 2, 3, 4, 6, and 7. He says they are mechanical or automaton musicians which were stationed, generally, at the entrance of the manufactory, for the purpose of serenading ladies and gentlemen who came to purchase the splendid productions of Arphaxad's looms. These figures serenaded all good customers, also, when leaving the factory; but in no case would they play a single note to such as were shabby in purchasing. Each figure was possessed of the necessary mechanism, in its interior, according to its office in the band. The playing of a tune, commonly averaged from 35 to 45 minutes; and there were 140 tunes, in all, "to the round." Each automaton was furnished with a suitable key, by means of which *it wound up itself* when run down.

In regard to stopping the engine on the breaking or failure of a weft thread, no difficulty could have been experienced; because the fork and grid stop thread motion, (a fragment of which you will perceive in the drawing,) would accomplish that object effectually. Besides, there are evident traces of other valuable contrivances for the same purpose: but whether these were ESSENTIAL to the perfect working of this extraordinary loom, or not, is at this moment a mystery beyond my power to solve.

His Highness is delighted with the working of your power looms; he has lately caused them to be set up in his turban factory, and they are now in successful operation. He requests me to convey to you the expression of his sincere regard, in the shape of a beau-
 * * * * * , and shipped this day on board the Royal Tar. I herewith enclose the invoice.

I have just learned that our respected friend, Amasis Osirtasen, is no more, having departed this life yesterday (Sunday) while in the act of
 * * * * * !

Hoping the above information will prove satisfactory, I remain, with permission from his Highness,

Your most obedient servant,

ALEXIS KERSIVENUS,

Civil Engineer, Homeopathic Physician, &c.

SECTION FIRST.

PLAIN WEAVING.

WINDING OR SPOOLING.

THE common custom of spinners is, to reel the yarn into hanks, or skeins of a given length, and in this state, to deliver it for the purpose of being made into cloth.

This process does not come within the compass of the present section; although the arts of spinning and weaving, which form the two great divisions of labour in manufacturing cloth from the raw material, are so intimately blended, that hardly any thing analogous to the one art, is entirely foreign to the other. At present it will be sufficient to consider yarn in the hank state.

The first process in linen and cotton yarn, is boiling in the hank. The fibres of the former, being long and tenacious, require only to be freed from impurities by means of boiling water, and soap or potash. To the latter a certain proportion of flour is added, to increase its firmness. When these operations have been performed, and the yarn has been thoroughly dried, it is wound upon bobbins, commonly called spools. This is done, generally for hand looms, by means of the common bobbin wheel, and swifts or runners, which are so well known that we think it unnecessary to give drawings of them.

WARPING.

The warping mill forms a circle, or rather a polygon inscribed within a circle, and the yarn is wound around it in the form of a spiral or screw, by which means a very great length may be produced in a small compass. Warping mills, for hand looms, are constructed of different heights and circumferences, according to the particular species of goods for which they are designed, or the

room which they are to occupy. A plan and elevation of those used in the manufacture of silk, cotton, and other goods will sufficiently illustrate the principle of their construction, and these will be found in figs. 3, 4, and 5.

Figs. 3 and 5.

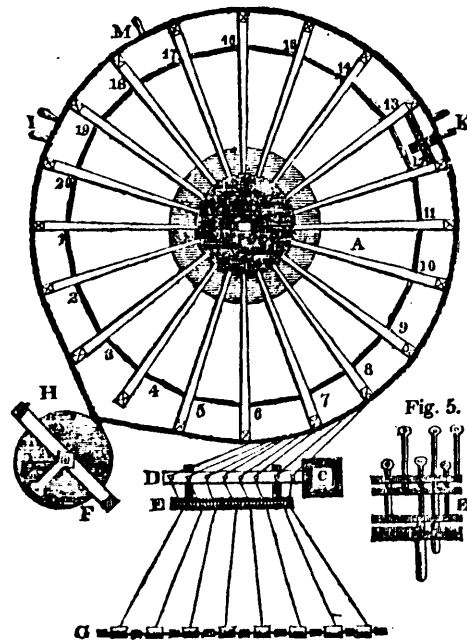
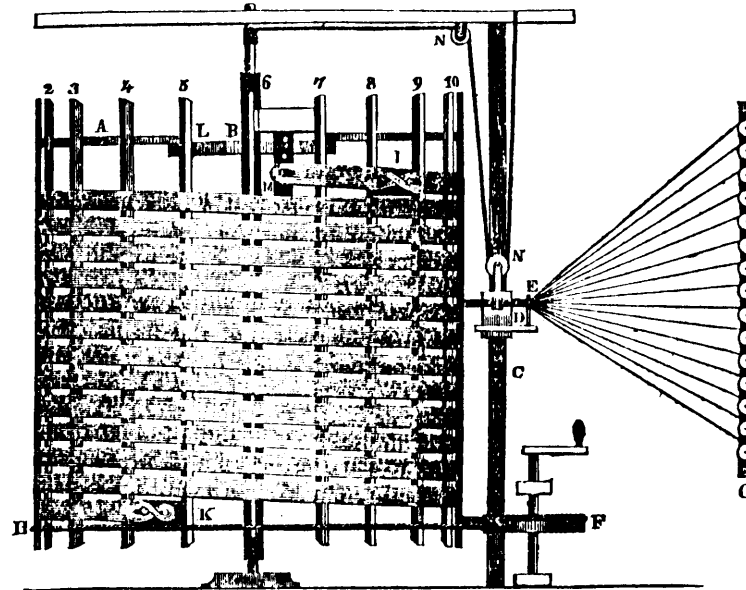


Fig. 3 is a ground plan and Fig. 4 a profile elevation, and the same letters refer to corresponding parts in both figures. The circumference of a mill is generally five English ells of 45 inches each, and is divided into 20 equal parts of $11\frac{1}{4}$ inches or $\frac{1}{4}$ of an ell to each. The mill is built upon three horizontal frames, one of which is represented at A Fig. 3. The circular piece L is of solid wood with a mortise B in the centre, having a square axis passing through it, in each end of which axis is an iron pivot or journal. The lower pivot works in a socket and the upper in a round hole or bush, the axis being placed perpendicular to the horizon. The mill is turned about by a trundle F, from which motion is communicated to it by a crossed band H, passing around its circumference, as near to the floor as convenient. The arms or radii (20 in number) are dovetailed into grooves in the centre piece L, and their extremities are mortised into the upright standards which form the circumference of the mill, and which being exactly $11\frac{1}{4}$ inches

asunder, from centre to centre, divide that circumference into 20 equal parts. The arms are numbered from 1 to 20, and appear very plainly in Fig. 3; but the standards at their extremities appear only as sections.

Fig. 4.



In Fig. 4 nine of the upright standards are quite visible, and are numbered from 2 to 10. Near the circumference the arms are connected and kept firm by round pieces of wood, as represented in Fig. 3.

E is the *heck*, as it is usually called. It consists of a number (120, or more,) of steel pins, with a round hole or eye in the upper end of each, through which a thread passes in the process of warping. The pins are placed alternately in two frames, distinct from each other, and either of them may be raised at pleasure. By these means what is called the lease is formed, and it is most essential in every stage of the operation of weaving, as the whole regularity of the yarn in the loom depends upon it. Fig. 5 is a front elevation of a part of a heck, for the purpose of showing more distinctly the way of lifting the alternate threads, when required. The steel pins of the heck ought to be very carefully polished for the sake of smoothness, and should be tempered hard, to preserve the eyes from being worn by the friction of the threads passing through them.

D is a frame of wood, on the upper part of which are fixed a convenient number of pins, in a perpendicular direction, and at equal distances. Upon each of these is a small pulley of hard wood, which runs freely round. These serve to guide the yarn upon the mill, and also to divide it into portions called *half gangs* or *bouts*, which are useful in the subsequent operation of *beaming*, as will be hereafter described. On the end of the frame D is a square box, through which a perpendicular post C passes, and upon it the whole frame D slides up or down, when the mill is set in motion. This is effected by means of a cord passing over the pulleys NN, Fig. 4, and fixed to the end of the axis of the mill.

When the mill is turned one way, the cord winds around the axis and raises the frame D; when turned the contrary way, the cord unwinds and the frame is lowered. Four small rollers are generally placed in the inside of the box to diminish the friction of the post C. G. Fig. 3, is a horizontal section of the frame for containing the bobbins, or as it is commonly called the *bank*.

Two cross pieces of wood, I and K, pass between the upright standards which form the circumference of the mill; in each of them are two smooth round pins, on which the leases are formed. Near to the upper lease pins I, is another pin M, and upon this the warp is turned. The cross piece I is fastened to the mill, but that at K is moveable.

OPERATION OF WARPING.

The number of bobbins which are to form the warp are placed in the frame or bank G, so that the threads may unwind from the upper part of them; the threads are then passed successively, through the eyes of the heck E, and the whole being knotted together are fixed to the pin M, upon the mill, (see Fig. 3.) The mill is then turned slowly, until the top lease pins at I, come nearly opposite the heck. The warper then, lifting half of the frame or thread guide, passes the forefinger of his left hand through the space formed between the threads which are raised and those that remain stationary; he then sinks the frame which had been lifted, to its former place, and lifts the other. (One half of the threads in the gang or bout passes through each of these guides.)

Into the space formed by this he inserts his thumb, and carefully places the yarn upon the two pins at I, the first passing through the interval kept by his fingers, and the second through that kept by his thumb. Every alternate thread is thus crossed and the lease

is formed. He now divides his yarn into portions, as nearly as possible equal to each other, to form half gangs. These are kept separate by passing along different rollers on the frame D, (see Fig. 3,) until he arrives at the lowest lease pins K. Turning the mill gradually and regularly round, he winds the yarn about it in a *spiral*, formed by the descent of the frame D, until he has completed a number of revolutions sufficient to produce the length of the web, and then fixes the lower pins at the proper place. Upon these he turns his warp, forming another lease, by passing every division, or half gang of his yarn, alternately, over and under each pin. This lease differs from that formed upon the upper pins only in this respect, that instead of being formed by the crossing of the individual threads, it is produced by crossing the half gangs, and is used, as formerly stated, in order to preserve regularity in the operation of beaming. The lower lease being now formed, the warper turns the mill in a contrary direction until he arrives again at the top, and repeats the former process till he has collected upon the mill the quantity of warp required in the web. As soon as this has been effected, he secures his leases, by tying round one half of the yarn upon each pin, cuts away his threads, and drawing the warp gradually off the mill, links it into a succession of loops called a *chain*, forms it into a bunch, or ball, and in this state it is delivered to the weaver.

In this consists the whole operation of warping. It is an important part of the duty of a warper to be very careful that any threads which may be broken in the process, be immediately tied, that they may not be crossed over the others.

We shall now proceed to the next operation, which is Beaming.

BEAMING.

When the weaver has received his warp, his first care is to wind it upon the beam in a proper manner.

Having ascertained the number of half gangs, and the breadth of the web, he passes a small shaft through that formed by the first. This gives him the lease for beaming, and keeps the half gangs distinct. An instrument or utensil called a *ravel* is then to be used. We have not given any figure of this because it differs in nothing from a *reed*, excepting that the intervals are much wider, and that the upper part may be taken off, for the purpose of putting the half gangs in their respective places.

Ravels, like reeds, are of different dimensions, and one proper for

the purpose being found, every half gang is to be placed in an interval between two of the pins.

The upper part or *cape*, is then put on and secured, and the operation of winding the warp upon the beam commences.

Two persons are employed to hold the ravel which serves to guide the warp, and to spread it regularly upon the beam; one, or two to hold the chain, or chains of the warp, (there is often more than one chain in the web,) at a proper degree of tension, and one, or more to turn the beam.

DRAWING OR ENTERING.

Two rods are now inserted into the lease formed by the upper pins on the warping mill, and the ends of these rods are tied together, the warp being spread out to its proper breadth. The beam is then suspended, by cords behind the headles, sufficiently elevated to be out of the way of the person who hands in the threads to the weaver, the warp hanging down perpendicularly. The weaver opens every headle in succession, and it is the business of the other person to select the threads in their order, and deliver them to be drawn through the open headle, or headles. The succession in which the threads are to be delivered is easily ascertained by the rods, as every thread crosses that next to it. The warp, after passing through the headles, is next drawn through the reed by an instrument called a *reed hook* or *sley hook*, two threads (for plain cloth) being generally taken through every interval.

These operations being finished, the *cords* or *mounting*, which moves the headles, are applied, the reed is placed in the lay, and the warp is divided into small portions, which are tied to a shaft connected by cords to the cloth beam. The weaver then dresses or sizes a portion of his warp and commences the operation of weaving. But before entering into the investigation of this process, it may be proper to devote some attention to the construction of the loom.

The most essential working parts of this machine are represented in Figs. 6 and 7.

Fig. 6.

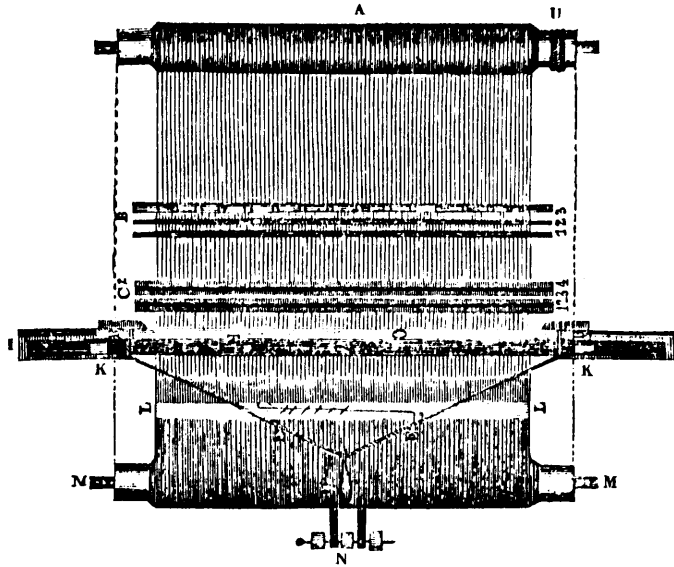


Fig. 6 is a ground plan, or rather a horizontal section of a common loom, parts of which are cut away, for the purpose of showing in their proper forms other parts of the loom, warp, and cloth, as they could not be otherwise represented.

Fig. 7.

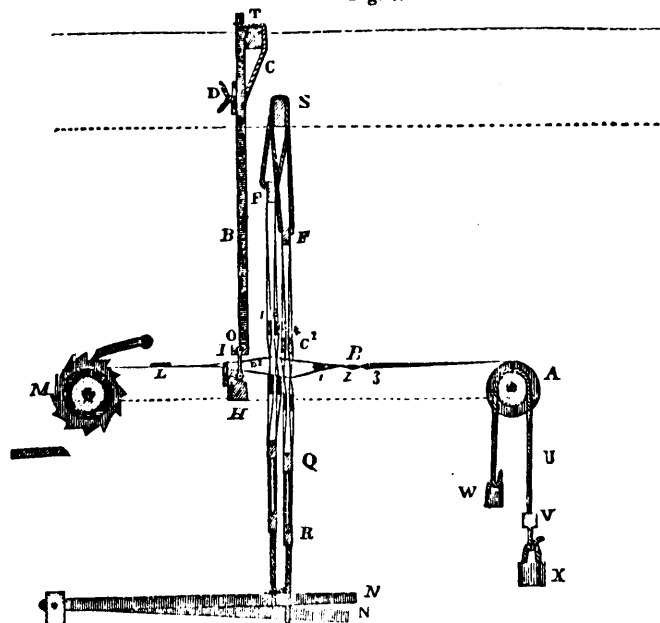


Fig. 7, may be considered either as a profile elevation, or as a profile section of the same loom.

All the parts in Fig. 7, are represented as they appear to a person standing at one side of the loom, and many parts, concealed or cut away in Fig. 6, are seen very plainly in Fig. 7, whilst many parts which are distinctly seen in Fig. 6, are, of necessity, either partially or totally hid in Fig. 7.

Fig. 8.

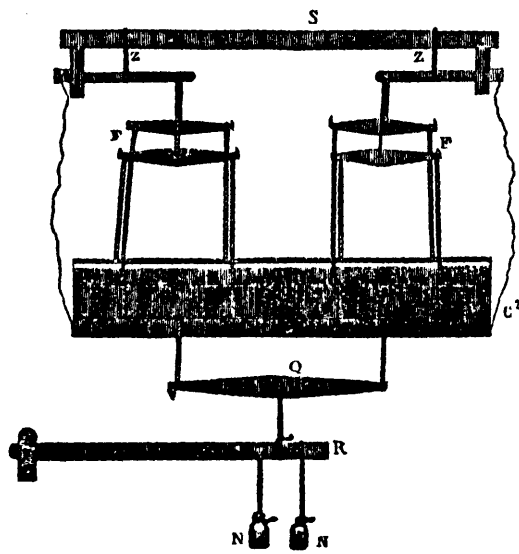


Fig. 9.

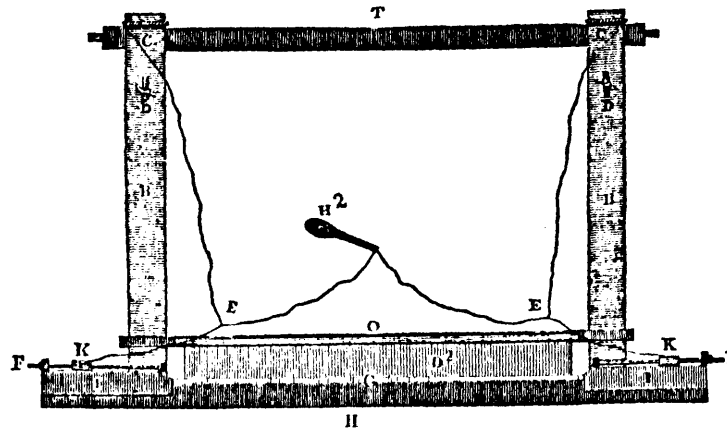


Fig. 8, is a transverse section of the same loom, as viewed from the front ; the cloth roll, the lay, and all the other parts in front of

the headles, are taken away that the mounting contained in the figure may be seen. The lay and reed, which are left out of Fig. 8, are distinctly represented in Fig. 9. In all these figures the same parts of the loom are marked by the same letters, and thus by comparing the figures, every part is shown in the various forms, in which it would appear when viewed above, in front, or at one side.

It has been deemed best, totally to omit the side and cross frame work, and to exhibit only the *working* or *moving parts*. This has been done for two reasons.

First, Because the construction of the frames of looms are very different, and the particular form, is not often essential to the operation, but may be varied according to the fancy either of the weaver or loom maker,

The dimensions also vary according to the nature and breadth of the work for which the loom is intended.

The strength of the different parts must depend entirely upon the work to be performed; for it will be obvious, that the quantity of wood necessary to give sufficient strength to the posts and rails of a sail cloth or a sheeting loom would prove a useless encumbrance, and add an unnecessary weight to one designed for weaving light fabrics of silk or muslin.

It is sufficient therefore, in constructing the frame work, that care should be taken to make it of strength equivalent to the stress of the work which is to be performed, that the parts should be accurately squared, the joints tight and firm, and that the frame should be well fitted to the working parts. If these points are sufficiently attained the most simple and least expensive plan of construction must in this, as in all other machinery, prove invariably the best. The second reason for omitting the frame work is, that it would have been difficult to represent the working parts distinctly without many additional drawings, because, in most instances, many things would have been concealed by the intervention of different parts of the frame, which will prevent unskillful persons from properly understanding it.

The following are the principal working parts of the common loom : A, Fig. 6, the yarn beam, B the rods which keep the threads of the warp in their respective places. The rods pass through the intervals which form the lease, that is to say, a thread passes *over* the first rod, and *under* the second : the next passes *under* the first and *over* the second, and so on alternately.

By this contrivance every thread is kept distinct from that on

either side of it, and if broken, its true situation in the warp may be easily and quickly found. This is of such importance that too much care cannot be taken to preserve the accuracy of the lease. The third rod divides the warp into what is usually called *dentfuls* or *splitfuls*, for two threads pass through the same interval betwixt the dents of the reed: a close inspection of the lines which represent the threads of the warp in Fig. 6, will serve to illustrate this, for the lines are drawn so as to show the way in which each thread passes between the rods. The third rod is commonly, although improperly, called the *lease rod*, for all the rods are lease rods, and the preservation of the lease is the chief cause of using them. C², the headles through which the warp passes, and which by raising and sinking one half of the warp alternately, form the spaces or sheds to receive the weft. D² the reed through which also the warp passes, (two threads being drawn through every interval,) and which, moving along with the lay, strikes home the weft to form the cloth, H, the lay, (see Figs. 6 and 9,) mentioned above, vibrating on centres, placed upon the upper rail or cape of the loom. II are the boxes for receiving the fly shuttle, and KK the drivers for giving motion to it: LL, the temples for stretching the cloth to a proper breadth, and MM is the cloth beam for receiving the cloth when woven.

Below the headles, and attached to them by cords, are two treadles NN, (see Fig. 7,) which are moved by the weaver's feet to open the sheds. The shuttle is driven through the shed by a motion communicated by the weaver's right hand, the lay being moved backward and forward by his left.

Before proceeding further, it may be proper to notice, briefly, the different parts of the loom in succession, to explain the nature of their construction, and their application to the purposes for which they are intended.

YARN ROLL OR BEAM.

In constructing this part of the apparatus particular care should be taken to select wood, perfectly sound, and thoroughly seasoned. Whilst the least moisture remains in the wood no operation performed upon it can be trusted. But it is absolutely necessary that the yarn beam of a loom should be, as nearly as possible, both perfectly straight and round. In proportion to any deviation from these, the loom will be defective, and the deficiency will prove injurious in proportion to the fineness of the cloth to be woven. It is therefore of the utmost consequence that the wood should be dry, and the

iron axles driven into it before the beam is turned, and that the turner should be very careful in the execution of this part of the work.

Upon this depends, in a great measure, the uniform tightness of the warp, and, of course, the beauty of the cloth. It is, besides, of the first consequence to the operative weaver, because, if the beam bends by twisting, one side will be heavier than the other, and oppose greater resistance to the threads of the warp, which may cause many of them to be broken. This greatly retards the work; for every operative weaver will be convinced, that he may throw many picks of weft sooner than he can tie one thread of warp.

The warp is kept in a proper degree of tightness by means of a cord U, (see Fig. 7,) rolled two or three times round one end of the yarn beam.

One end of this cord is fixed to a lever V. This lever, the end of which only can be seen in Fig. 7, and which does not appear at all in Fig. 6, is parallel to the beam, and directly under the back part of it, so that the cord passing from the lever to the beam, may be in a perpendicular direction. To the other end of the cord, after passing round the beam, is fixed a weight W. A heavier weight X is then hung from the lever V, and as this weight is moved nearer to, or further from the fulcrum of the lever, the tension of the warp will be increased or diminished. This apparatus is called a *pace*.

In heavy fabrics, it is still the custom, in hand-loom weaving, to tighten the warp by means of a stout pin, which is called a *bore staff*. The yarn beam of looms constructed for heavy work, seldom has iron axles, but is merely rounded at each end; and at the right hand side a number of holes, say six, are bored, and into one of them, one end of the bore staff is inserted, the other being drawn upwards by a cord, until the warp is sufficiently tight.

RODS.

As mentioned before, the principal use of the rods is to preserve the lease. When any threads of the warp are broken, great care ought to be taken to have them returned into their proper places. When this is neglected, the warp gets into confusion, and great trouble, and loss of time ensue. The rods are made of hard wood, and should be well smoothed, to prevent them from catching, or breaking the warp: the two front ones are of a circular form, the third or lease rod is flat, and broader than the others, which is convenient in the process of dressing the warp, as will be afterwards

described. The rods are kept at a uniform distance from the headles,* either by tying them together, or by a small cord with a hook at one end, which lays hold of the front rod, and a weight at the other, that hangs over the yarn beam.

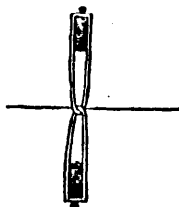
HEADLES.

To weave plain cloth, only two leaves of headles are really necessary, but in fine webs, where many threads are contained in the warp, the number of headles required would be so great, that they would be crowded too much together, which would cause unnecessary friction, and strain the warp. For this reason four leaves are now universally employed, except in very coarse work; they are made of stout smooth twine, composed of 9 strands, and are connected together by cords above and below, to which each headle leaf is fastened. They are then stretched on two thin flat shafts of wood.

The upper edges of these four shafts are represented in Fig. 6, at C, and the sections or ends of them at C², Fig. 7, where the front leaves appear raised, and the back ones sunk for opening the shed, through which the shuttle passes.

For plain work clasped headles are chiefly used; a representation of which, upon a large scale, is shown in Fig. 10,

Fig. 10.

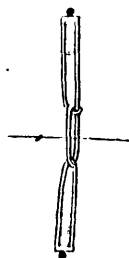


where the headle twine is represented by double lines, for the purpose of showing how the upper and lower parts cross each other. The cross line shows the direction in which every thread of the warp passes through the headle. For many kinds of work, the headles are constructed with eyes, one of these is shown in Fig. 11,

* The Irish linen weavers always have the front rod (or rod No. 1.) from $3\frac{1}{2}$ to 4 inches from the back headle; and in plain cotton goods, the distance at which they are kept separate seldom exceeds 5 inches. The grain of the cloth, we know from experience, is better, when the rods are kept about 4 inches from the back headle, than at a greater distance.

which will also explain, by inspection, the way in which the twine is knotted to form the eye.

Fig. 11.



In Fig. 8, which is an elevated section, as seen from the front, they are distinctly seen, and the construction of the whole is rendered very apparent. On the upper side rails of the loom rests the headle bearer *S*, stretching across the loom. From this two levers *Z*, are suspended by cords; from one end of these levers are hung the jacks *F*, and from each end of these jacks pass the cords which connect them with the upper headle shafts. The cord connecting one end of each jack with the headles, is attached to the first and second leaf, and that connecting the other end, to the third and fourth leaf. Under the headles are two spring staffs *Q*, suspended by cords from the under headle shafts. These are connected with the two marches *R*, which move upon joints, and the marches are again connected with the two treadles, from which the whole motion is derived. The other end of the lever *Z* is connected by a small cord with the under headle shafts, and this end rests in a small notch, fixed to the side frame of the loom. When the headles are to be pushed back, the levers are relieved from the notches; the weaver then presses down the upper shafts, by means of the small cords, the under shafts are at the same time raised, and thus the headles are slackened to ease the warp. When headles with eyes are used, this apparatus is unnecessary, and the jacks may at once be hung from the headle bearer *S*, as in Fig. 7. Another way of easing the headles is now most generally practised; the lower links, or *doups*, are lifted by small rods, and the headles are pushed back by moving the lay.

In drawing the warp through the headles, the first thread is taken through the fourth or back leaf, the second through the second, the third through the third, and the fourth through the front. When it becomes necessary in the after process, occasionally, to draw out the rods, their places may be recovered in the following manner:

By raising the third and fourth leaves and sinking the first and second, the place of the second rod is given ; and by reversing this, we find that of the first. By raising the first and third leaves and sinking the second and fourth, we obtain the place of the lease rod.

LAY AND REED.

Fig. 9 is an elevation of the lay and reed, taken from the front, and exhibits very plainly those parts which are either concealed, or imperfectly seen in the plan and profile, Figs. 6 and 7. The parts of the lay are as follow : H is the sole or shell of the lay, in which there is a groove to receive the lower edge of the reed D² ; O is the top shell, in which also is a groove, and by these it is kept in its place ; BB are the two swords or supports of the lay, which are suspended from the rocking tree T, by means of cords CC, as represented more clearly in Figs. 7 and 9. When the pins at DD are turned round, they twist the suspending cords, which of course, become shorter. By these means either end of the lay may be elevated or depressed at pleasure, to bring it into a proper working position. Instead of these cords, screws are sometimes used, which is certainly a steadier, though a more expensive plan. The boxes II are constructed of a proper size to receive the fly shuttle, which is driven from either by pulling forward the driver K, sliding freely on the polished spindle F ; it then passes along the race G, with great velocity, and lodges in the opposite box.

The drivers are moved by the cords EF, fastened to the handle H², which the weaver moves with his right hand, as before mentioned.

In weaving light fabrics of cloth, the upper rib of the reed is not confined in the shell of the lay, but a light shaft of wood with a groove is used. To each end of this shaft is fixed, at right angles, a thin flat piece of wood, which springs easily backward and forward.

The extremities of these pieces are nailed to the back of the swords of the lay, and a cord is tied round both, by which the degree of spring may be regulated, the rib of the reed is received into this groove, and the shell is to be used above the vibrating reed, serving merely as a rest for the weaver's left hand to work the lay.

By this contrivance the reed yields when the weft is driven up, and diminishes the danger of making the cloth too thick. These machines are called *flyers*. In still lighter goods, a woollen cord is stretched between the swords, and to it the upper rib of the reed is tied.

The regularity of the cloth depends much upon the evenness of the dents of the reed, and if this is neglected the warp will be frequently broken, and the texture of the cloth impaired.

The dents ought not to be perfectly flat, but thicker in the middle, and tapering to either edge. This not only diminishes the friction on the warp, but will allow any small knot or lump to pass much easier without breaking the thread.

The fineness, or as it is called among weavers, the *set* of a web, is determined by the number of dents of the reed in a given length. The reed is divided into hundreds, and these again into five parts, each containing twenty dents. A reed for working hollands is considered to be 40 inches in length, for linen 37 inches, and for cambric 34 inches; and the number of hundreds contained in these respective lengths is called the *set*. It is probable that these lengths owed their origin to the breadths of which it was customary to weave these different kinds of cloth.

The 40 and 34 inch reeds are now very little used, and the 37 inch, or linen reed, is universally adopted, at least in the cotton manufacture. The cause of this seems to be founded upon considering a yard of 36 inches as a proper standard, and as most kinds of cloth shrink considerably in the breadth, the additional inch is, no doubt, allowed for this. But the shrinking of cloth is very different in various fabrics. Cloth of a stout, thick texture requires a much greater allowance than light goods. The additional quantity of warp is, therefore, allowed by the manufacturer, in proportion to the quality of the web, and this is regulated by observation and experience.

The length of the Scotch yard is 37 inches, and it *probably* bears this proportion to the English yard of 36 inches for a similar reason. In Lancashire and the adjoining counties, where the manufacture of cotton goods, chiefly thick fabrics, is carried to a very great extent, a mode of counting their reeds, different from any of those above mentioned, is in use.

Their reeds are divided into portions of 19 dents each, which they call *beers*, and the number of these, contained in 24 inches is called the number of the reed.

TEMPLES.

The temples, by which the cloth is kept extended, during the operation of weaving, consist of two pieces of hard wood, with small sharp points in their ends, which lay hold of the edge, or sel-vage of the cloth at either side.

The pieces are connected by a cord, passing obliquely through holes or notches in each. By this cord they can be lengthened, or shortened, according to the breadth of the web. They are kept flat after the cloth is stretched, by a small bar, turning on a centre. Their form will appear very plainly at L, in Fig. 6; one end is seen at L, Fig. 7.

CLOTH ROLL OR BEAM.

Behind the temples is the roller over which the cloth passes, as fast as woven, (this roller should be well seasoned, and turned very true,) and is then wound on the cloth beam MM. When the warp has been wrought up as near to the headles as can be done conveniently, the weaver shifts forward the temples, rolls up a proper quantity of cloth, which unwinds an equal length of warp, then shifts back the rods and headles, until the latter hang perpendicular, and proceeds with his weaving.

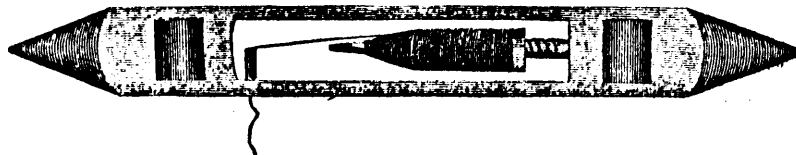
This is called *drawing a bore* by the Scotch, and a *sink*,* by Irish linen weavers.

In weaving thick and bulky fabrics of cloth there is a cross beam of wood called the *breast beam* instead of the small roller.

SHUTTLE AND QUILL.

The shuttle is made of well seasoned *box wood*, or of *apple tree*, and tipped with steel at each end; it runs upon two small wheels of iron, or wood, hung on centres; the weft thread, escaping from the quill, passes through a small eye of glass, or ivory, inserted in the side of the shuttle, next to the cloth. Fig. 12 is a representation of both.

Fig. 12.



In the woollen and cotton manufactures, the use of the fly shuttle is almost universal; but in the linen and silk it is still common to pass the shuttle through the warp by the weaver's hand. The boxes, drivers, spindles, and other apparatus used for throwing the

* So called from the weaver's depressing one end of the bore staff, in drawing off yarn from the warp beam.

fly shuttle, are unnecessary in working by the hand, and would, indeed, be encumbrances.

OPERATION OF WEAVING.

When a warp has been properly arranged in the loom, and all the machinery requisite for weaving it into cloth has been added, the business of the operative weaver depends more upon care and attention, than upon manual dexterity. *Silk* and *woollen* warps, which are animal substances, require little preparation after being put into the loom. In these it is only necessary for the weaver, occasionally, to clear his warp behind the rods, and to pick off, or pare away, any knots or lumps upon the yarn, which might present obstructions in passing through the headles or reed.

The clearing of the warp is generally done with a comb, which is drawn gently through it, the teeth being kept in an oblique direction, in order to avoid breaking the threads, when any obstruction presents itself.

For the operation of cleaning the warp, a pair of small shears is used. This operation is equally necessary in warps spun from the vegetable substances, *flax* and *cotton*.

But they require besides, a further preparation to fit them for the purpose of weaving : this is called

SIZING.

This operation is justly esteemed of the first importance in the art of weaving warps spun from flax or cotton, and even in fine woollen fabrics ; for it is impossible to produce work of a good quality unless care be taken in sizing the warp.

The use of this process is to give to yarn sufficient strength or tenacity, to enable it to bear the operation of weaving. It also, by laying smoothly all the ends of the fibres which compose the raw material, from which the yarn is spun, tends both to diminish the friction during the process, and to render the fabric smooth and glossy. The substance in common use for sizing, is simply a mucilage of vegetable matter boiled in water. Wheat flour, and sometimes potatoes, are the substances commonly employed for cotton and linen. These answer sufficiently well, in giving to the yarn both the smoothness and tenacity required ; but the great objection to them is, that they are too easily and rapidly affected by the operation of the atmosphere. When dressed yarn is allowed to stand exposed to the air for any considerable time, before being woven

into cloth, it always becomes hard, brittle, and apparently inflexible. It is then tedious and troublesome to weave, and the texture of the cloth is rough, wiry, and uneven. This effect is chiefly the case in dry weather, when the weavers of fine cloth find it indispensibly necessary to have their yarn wrought up as speedily as possible, after being dressed.

To counteract this inconvenience, herring, or beef brine, and other saline substances, which have a tendency to attract moisture, are sometimes mixed in small quantities with the sizing: but this has not proved completely successful, probably because the proportions have not been properly attended to, and because a superabundance of moisture is equally prejudicial with a deficiency. Indeed, the variation of the moisture in the air is so great and so frequent that it appears difficult, if not impossible, to fix any general, not to say universal rule, for the quantity to be mixed.

It will appear singular to weavers in this country, that in India, the process of weaving even their finest muslins, is conducted in the open air, and exposed to all the heat of the climate, which is intense.

We know well that by the common mode such would be impracticable with fine work in this country, even in an ordinary summer day. Weavers are obliged to work in damp shops, to prevent the size of the web from drying and hardening. It does not appear that this subject, which is of much importance, has, till lately, attracted the attention of scientific men; nor has it been treated in an accurate or philosophical manner. We have, very recently, been fortunate enough to procure some account of the substances which the Indian weavers employ for sizing their warps, and we gladly embrace this opportunity of making it publicly known, as we hope the information will prove an important benefit to the manufacturers of this country.

M. Dubue has lately read a memoir before the '*Academy of Sciences of Rouen*,' on the subject of '*Pastes, &c.*' in which he shews, that the Indians use a very minute addition of *muriate of lime*,* to render them retentive, or absorbent of moisture. "Webs," says he, "sized with such paste as is generally used in this country, (France,) may be woven in the *upper* and *drier* chambers of a house, as well as in the lower and ill aired.

Muriate of lime may be obtained at a very trifling expense from those apothecaries, or others, who prepare water of ammonia.

* Monsieur Dubue should have likewise informed us where the Indians procured their *muriate of lime*.

The waste whitening steep of the bleacher is merely a solution of muriate of lime."

The Indians also, according to Forbes, use a kind of size which they make from a root called *kandri*.

In the sizing of woollen warps, glue is most commonly used. When the warp previously sized has been wrought up, as far as can be conveniently done, the weaver is obliged to suspend the operation of weaving, and to prepare a fresh quantity of warp. It is necessary to stop when the sized warp has approached within two or three inches of the back leaf of the headles, that room may be allowed to join the old sizing to the new. The first operation is to clear the warp with the comb, from the lease rod to the yarn beam, and the proof that this operation has been properly executed is, by bringing the rods, successively, from their working situation to the beam. When this has been done, the two rods nearest to the headles, are drawn out of the warp, and the lease rod only remains.

The next duty of the weaver is to examine the yarn about to be sized, and carefully to take away every knot, lump, or other obstruction, which might impede his progress, or injure the cloth. This being performed, he proceeds to apply the substance used for sizing, which should be rubbed on gently, but completely, into the whole warp, by means of two brushes, used in succession, one of which he holds in each hand. He then raises the lease rod on one edge to divide the warp, and sets the air in motion by means of a large *fan*, for the purpose of drying the warp which has been sized. It is proper in this stage of the operation, to draw one of the brushes *lightly* over the warp at intervals, in order to prevent any obstruction which might arise by the threads when agitated by the fan, cohering, or sticking to each other, whilst in a wet state. When the warp is sufficiently dried, a very small quantity of grease (tallow) is rubbed over it, with another brush kept for the purpose, the lease rod is again placed upon its flat side and cautiously shifted forward to the headles. The other rods are then put again into their respective sheds, and the process is finished.

WEAVING.

The operation of sizing the warp being over, the weaver again resumes that of forming the cloth. The operations required are only three; and these are very simple:

1st, *Opening* the *sheds* in the warp, alternately, by pressing down the treadles with his feet.

2d. Driving the shuttle through each shed when opened. This is performed by the right hand, when the fly shuttle is used, and by the right and left hand alternately, in the common hand loom.

3d. Pulling forward the lay to strike up the weft, and again pushing it back nearly to the headles. This is done by the left hand (as before stated,) with the fly, and by each hand successively in the old way. In describing operations so simple and uniform it is neither easy nor necessary, to go much into detail, and we wish above all to avoid repetition. It may be useful, however, in this place, to notice the mistakes into which inexperienced weavers are apt to fall, and the defects and inconveniencies which these occasion.

TREADING.

In the treading of a web most beginners are apt to apply the weight or force of the foot much too suddenly. The bad consequences attending this mistake are particularly felt in weaving fine or weak yarn. In weaving, as in every other branch of mechanics, the resistance, or reaction, is always nearly as great as the moving power or force which it is necessary to apply. From this it follows, that the body of the yarn must sustain a stress, nearly equal to the force with which the weaver's foot is applied to the treadle.

Besides this, every individual thread is subjected to all the friction occasioned by the headles and dents of the reed, between which the threads pass, and with which they are generally in contact in rising and sinking.

But the art of spinning has not been, as yet, and probably never can be, brought to such a degree of perfection, as to make every thread capable of bearing its proportion of the stress equally. It is alike confirmed both by mathematical demonstration, and by practical experience, that when any body is to be moved with increased velocity, it is necessary to exert greater power to move it; and as the resistance increases in proportion to the power, this sudden application of the pressure of the foot to the treadles, must cause a proportional increase of the stress upon the warp, and also of the friction.

Now as it is *almost* impossible to make every thread equally strong, and equally tight, those which are the weakest, or the tightest, must bear much more than their equal proportion of the stress. This causes them frequently to break, even with the greatest attention, and more time is lost in tying and replacing them, than would

have been sufficient for weaving a considerable length of cloth. But if the weaver, from inattention, should continue the operation, after one, or more threads are broken, the consequence would be still worse. When a thread has been broken it no longer retains its parallel situation to the rest, but crossing over, or between those nearest to it, either breaks them also, or interrupts the passage of the shuttle; frequently it does both. The same reasons will sufficiently prove the error of another opinion, too common among conceited or ignorant weavers, especially the younger part of them. This is, that a greater quantity of cloth will be produced, in proportion as every motion is performed with increased rapidity. It is unquestionably true, that time will be lost by conducting the operations too slowly: but it is equally certain, that there is a rate of velocity, beyond which it is improper to accelerate the motions of a loom. What the precise rate of this velocity in hand loom weaving should be, has not, as we believe, been correctly ascertained. Indeed, it must vary considerably, according to the breadth of the web, the skill of the workman, the nature of the fabric, and the strength of the materials.

Instead, therefore, of giving precise rules of motion, we shall here insert a few calculations of the quantities of work which may be produced by uniform and incessant motion, at rates usually reckoned slow.

In a 4-4 cotton shawl, let the warp be 1000, and the weft 1200, it will follow, that the shuttle must be driven 2400 times across the web to produce one square yard of cloth. Now, if this is done 60 times per minute, the whole will be completed in 40 minutes, supposing no time to be lost. But as this is *scarcely* possible, allow *one fifth* of the time to be occupied in tying threads, changing quills, and other necessary operations, and still the yard of cloth will be completed in 50 minutes.

Again, in a 1200 6-4 web, (*even wofsted*,) let the time of weaving a yard *in length*, be computed at the rate of 40 picks per minute; this, with the former allowance of one fifth part of the time for stopping, will be done in *one hour and 15 minutes*. Yet every *experienced* weaver will be satisfied that looms, regularly and constantly kept going at the above rates, will produce more cloth than is usually effected, even by the most rapid motions.

No allowance is made here for the time employed in sizing, because this is supposed to be the same whether the weaving is performed quickly or slowly.

These illustrations, which are confirmed by the practical obser-

vation of every experienced weaver, will be sufficient for the present. The subject will be more fully discussed, when we come to investigate the methods of weaving *by power*.

We shall then treat of sizing whole webs by the aid of machinery, and of the best rates of speed adapted for weaving the various kinds of goods to which power can be applied.

CROSSING THE SHUTTLE.

This, like the former motion, should be performed with a regular and uniform velocity.

In every kind of weaving, and especially in thin wiry fabrics, much of the beauty of the cloth depends upon the weft being well stretched. But if the motion of the shuttle be too rapid, it is apt to recoil, and thus to slacken the thread. It has also a greater tendency either to break the weft altogether, or to unwind it from the quill in *doubles*, which, if not picked out, destroy the regularity of the fabric. The weft of muslins and thin cotton goods, is generally woven into the cloth in a wet state.

This tends to lay the ends of the fibres of the cotton smooth and parallel, and its effect is similar to that of sizing the warp.

The person who winds the weft upon the quill or bobbin must be very careful that it be well built, so as to unwind freely.

The best shape for those used in the fly shuttle, is that of a *cone*,* and the thread should traverse freely, in the form of a spiral or screw, during the operation of winding.

The same wheel used for winding the warp upon bobbins, is also fit for winding the weft. It only requires a spindle of a little different shape. The wheel is so constructed, that the spindles may be easily shifted, to adapt it for either purpose.

STRIKING UP THE WEFT.

That the cloth may be uniform in thickness it is necessary, that the lay should be brought forward with the same force every time. In the common operation of weaving, this regularity must be acquired by practice.

* Messrs. Farquhar and Gunn of Glasgow, Scotland, make the best fly-shuttle bobbin winding machines in Europe, and particularly for power looms, where striped or checked goods are woven. These machines contain from 12 to 100 bobbins each, which they build in the form of a cone. We would advise manufacturers of such goods to procure sample machines from these gentlemen.

It is, however, of consequence to the weaver, to mount his loom in such a manner, that the range of his lay may be in proportion to the thickness of his cloth. As the lay swings backward and forward, upon centres placed above, its motion is similar to that of a pendulum; and the greater the arc or range through which it passes, the greater will be its effect in pressing up the weft. For this reason, in weaving coarse and heavy goods, the headles should be hung at a greater distance from the point where the weft is struck up, than would be proper in light work. The point, or rather line, where the last thread has been struck up, is called by weavers the *fell*.

The pivots upon which the lay vibrates ought, in general, to be exactly at equal distances from a line drawn perpendicular to the fell, and one drawn perpendicular to the headles, and between these two lines. But as the fell is constantly varying in its situation, (in hand loom weaving) during the operation, it will be proper to take the medium. This is the place where the fell will be when a *bore* (one pull of the warp) is half wrought up.

From this the following conclusion may also be drawn :

The *bores* ought always to be *short* in weaving light goods; for, the less the extremes vary from the medium, the more regular will be the arc, or swing of the lay.

The result of what has been stated above is, that in each of the three operations of weaving, the motions should be constant and uniform, and, that they should follow each other in regular succession. But some observations will be necessary to adapt these to different species of cloth.

The beauty or excellence of some cloths consists in the closeness of their texture, that of others in the openness and regularity of the intervals between the threads. When the latter of these is required, the weaver must vary his process from that which would be proper in the former.

The extreme tightness of the weft is a principal excellence in open goods, and is, to a certain degree, necessary in the others; but by no means to the same extent; two alterations are, therefore, necessary in the formation of such fabrics. The first is in the mounting of the loom, the second, in the operation.

By referring to Fig. 7 it will appear, that the threads of the warp pass from the yarn beam to the cloth roller upon a level, or horizontal straight line, consequently, the half of the warp which rises and the half which sinks, will deviate equally from a straight line, and be equally stretched. When this is the case the threads of

warp which pass through the same interval in the reed, will appear close together in the cloth with a vacancy between them, and those next to them; which vacancy is caused by the intervention of the dents in the reed. But if the yarn beam is raised considerably above the level of the headles, the warp when at rest, will no longer be in a straight line; and when the shed is opened, that half of the warp which descends, will be drawn considerably tighter than the half which rises. Thus each half will be slackened alternately, and the consequence of this is, *that the warp spreads in the cloth, and the intervals caused by the dent of the reed are no longer discernable.*

The former of these ways of placing the loom is practised in thin work, the latter in thick.

When the weft has been thrown across the warp, *if the fabric is thin, the lay is brought up rather before the shed is closed*, in order that the weft may be struck up as tight or as stretched as possible; but in weaving thick goods, *the shed is closed before the stroke of the lay is given.*

In consequence of this, the threads of the warp, to a certain degree, slacken the weft, and give a close appearance to the cloth.

In weaving thick cotton goods, the weft is inserted in a wet state, when the fabric is wanted to appear very close.

It may now be proper to notice the defects which most commonly occur in the weaving of cloth, and to explain the causes from which they arise.

When from any cause, the weft is not regularly interwoven with the warp, a deficiency must happen in the cloth, which is called by weavers a *scobb* or *blotch*.

This may proceed from several causes, the most frequent is some obstruction in the warp, which prevents any portion of it from rising or sinking regularly when the shed is formed; of course, the shuttle, instead of passing fairly between the threads of the warp, passes either over or under the portion which is obstructed, and the weft at that place is not at all interwoven with the warp.

A knot or lump upon the warp, if not picked off, will often obstruct two or three threads, and form a small scobb. When the weaver, from inattention, continues to weave after a thread of warp has been broken, it very frequently crosses between a number of others nearest to it, and by obstructing the shed in that place, will cause a large scobb. Scobbs are also sometimes produced by the lay being too low or too high, but this is more frequent in weaving

with the hand shuttle than with the fly. In this case the scobbs are always near the *list or selvage* of the cloth.

A second fault in cloth is known among weavers by the name of a *jisp or shire*. This is most frequent in light fabrics, and is occasioned by any particular thread of weft not being struck up so close as the rest. Jisps are very frequently occasioned by defects either in the construction or mounting of the loom. If either the yarn beam or cloth beam be not turned very true, jisping will be unavoidable, or if either the headles or the lay be not hung parallel to the beams, the same defect will ensue. *If the loom is correctly made and mounted, the fault must be with the weaver, and this is only to be surmounted by attention and practice.*

The other faults in cloth generally proceed from inattention in the management of the warp or weft. If threads are inaccurately drawn through either the headles or the reed, the defect will be apparent in the cloth.

There is nothing that adds more to the beauty of cloth of every description, and about which good weavers are more solicitous, than a *tight uniform selvage*. In order to produce this, the warp must be sized even with greater care than what is necessary in the middle of the web. The tightness of the weft, also, contributes materially to the beauty of the selvage. It is sometimes customary to warp a few dentfuls at each selvage with coarser yarn than the body of the web. In many kinds of cloth, however, the common practice is to draw the threads which form the selvage double. That is, to draw two threads through each headle.

The threads which form the warp of the selvage being coarser than the rest, and also being drawn more towards the middle of the web by the weft, the intervals of the reed through which they pass, are apt to be worn much sooner than the others. A weaver should carefully attend to this, for if the reed is injured, the work cannot be good. When cane reeds are used, and when the webs wrought in them are of one breadth, it is very common to make those dents between which the warp of the selvages passes, of brass or steel.

It is unnecessary to enumerate further, the defects which may occur in the weaving of cloth, *for no instruction can altogether supply the want of skill, which is only to be obtained by practical experience.*

Having finished the foregoing general account of the nature and process of weaving, it now becomes necessary to pay some attention to the fancy and ornamental department of the business. Of fancy goods, many descriptions are woven in the common loom,

without any additional apparatus, and with little, if any, variation from the process of weaving plain cloths. The extent to which this species of manufacture is carried, renders it an object of very great importance, and the variation in the operative part of the process is so small, that it may be introduced under the description of plain weaving, with little violation of arrangement.

As the thickness of the texture of plain cloth depends upon the proportion which the fineness of the yarn bears to the measure or *set* of the reed, it follows, that if yarns of different degrees of fineness are introduced at regular intervals into the same web, two distinct textures, or qualities of cloth, will be produced, and that the appearance of these will be different when the web is finished. Yarns of different colours may also be introduced, and when either of these is practised the goods are called

STRIPES.

Stripes are formed upon cloth either by the warp, or by the weft. When the former of these ways is practised, the variation of process is chiefly the business of the warper, in the latter case it is that of the weaver. In extensive manufactories, where large quantities of striped goods of the same description are to be made, it is common to form the stripes in the warping, because in this case, the stripes and their distances from each other will be uniform, which cannot be always relied upon where the stripes are formed by the weft.

In warp stripes, where the colour is the same, and the difference is in the fabric, the effect may be produced either by using yarns of different fineness, or by drawing a greater quantity of warp through a given number of headles or intervals of the reed, where the stripes are to be formed. For example, two, or more threads, may be drawn through the same headle eye, or three, or more *headlefuls* may be drawn through the same interval of the reed, or thirdly, if the stripe is to be very thick, both these ways may be adopted.

CHECKS.

The patterns of checks may be either similar, or dissimilar in the warp and weft. The former is the most prevalent. Checks, being merely combinations of the two methods of striping, require no further description; and as they contain, most frequently, a mixture of colours, their beauty depends more upon the taste and fancy of the manufacturer and the skill of the dyer, than upon that of the

weaver, *whose business is merely to make the cloth of a good quality*, and insert his weft according to the pattern.

Stripes and checks are manufactured in great quantities from all the different materials, especially from woollen, silk, or cotton. When the patterns of checks differ at the borders from the middle or bosom of the web, they are called shawls or handkerchiefs. It is very common to weave these with borders only, the bosoms being left plain; in this case the check work is only at the corners, the rest of the four borders appearing as stripes, two by the warp, and two by the weft.

WARPING OF STRIPED WEBS, &c.

To compose a pattern for a striped web, you must begin by counting the number of threads in one stripe, then take half that number, if it is two threads per dent, if four, take the fourth of it; if 8 threads, $\frac{1}{8}$, &c., which will give the number of dents in a stripe. Measure the width of the stripe, so as to ascertain how many times it is to be repeated in the breadth of the web. Multiply the number of times by the dents in the stripe, and you will have the entire quantity of dents in the web. Divide the number of threads in the web by 80, and as 80 threads is a *porter*, you will thus find the number of porters. The following example will explain this:

Suppose that one stripe contains 100 dents with three threads in each, and that there are 10 stripes in the whole breadth of the web, we may find the number of patterns or repeats thus:

100	dents in the stripe
10	repeats or stripes

1000	dents in the web
3	threads per dent

80)3000	(37 Porters) Threads in the web
240	

600	
560	

40	threads over

By this we see that 3000 threads give $37\frac{1}{2}$ porters, 40 threads being half a porter.

SECTION SECOND.

TWEELING.

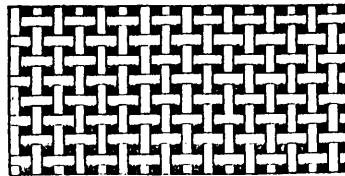
TWEELED CLOTH.

THIS species of weaving derives its name from the French word *touaille*, and is generally confined to thick fabrics.

In analyzing the texture of plain cloth, it has been shown, that every thread of the warp and of the weft cross each other at right angles, and are tacked together alternately. This is not the case in tweeling, for in this branch of weaving only the third, fourth, fifth, sixth, &c. threads cross each other. Tweeled cloths are produced of many different kinds. In the coarsest species every third thread is crossed, and this is commonly called the *blanket tweel*, in finer fabrics they intersect each other at intervals of 4, 5, 6, 7, or 8 threads, and in some silk stuffs the crossing does not take place until the 16th interval, which is denominated the *full satin tweel*.

Before proceeding further it may be proper to explain what is known among weavers by the appellation of *flushing*. When any thread or portion, whether of warp or weft, is *not regularly interwoven in the cloth, as in plain weaving, that thread or portion of threads is said to be flushed*. By referring to the following Figs. this will be more clearly illustrated.

Fig. 13.



In Fig. 13, which is referred to as a specimen of plain cloth, as it would appear *when viewed through a microscope*, the intersections of the threads are evidently alternate.

Fig. 14.

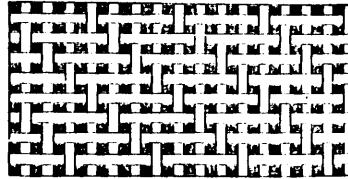


Fig. 14 may be considered as a representation of tweeled cloth, upon the same principle that Fig. 13 represents plain. This fig. will show that the same thread of weft remains flushed or disengaged from the warp while passing *over* three threads, and is tacked down by passing *under* the fourth. Now, were this cloth turned upside down, the same appearance would take place in the warp. That is to say, every fourth thread of the warp would be interwoven with the weft and the remaining three threads would be flushed. An inspection of the Fig. will also convince the reader, that the threads, both of the warp and weft, are interwoven at regular intervals.

To produce these effects a number of leaves of headles are required, equal to the number of threads contained in the interval between each intersection, *inclusive*. Thus, when every third thread is to be interwoven, three leaves are required; if every sixth thread, six leaves will be necessary; and so of all the others. For this reason, the different species of tweels are distinguished by the number of leaves which are requisite in weaving them, as a four, five, or six *leaf*, tweel, &c. The specimen in Fig. 14 is a four leaf tweel.

Tweeling is, in many instances, applied to the weaving of cloths which require a great portion of strength, thickness, and durability.

In the silk manufacture tweeling is very common. Sometimes it is employed for the sake of strength, but more frequently for the display of colour. In the woollen, strength is the general object, and in the cotton it is most commonly the same.

It may be necessary in this place to enquire into the causes which render tweeled cloths stronger than plain, and to ascertain the difference.

In so far as the strength of tweeled cloths depends solely on the mode of weaving, that strength will be rather diminished than increased, when compared with plain cloth, containing an equal quantity of similar materials. For in the texture of plain cloth every thread is alternately interwoven, while in that of tweels they

are only interwoven at intervals. Now, in the latter case, the threads can derive no mutual support from each other, except at the intervals where they are interwoven, and that part of them which is flushed must depend entirely on the strength of the individual threads, those of the warp being flushed upon one side, and those of the weft upon the other.

The following inference will naturally arise from this : let two webs of equal length, breadth, quantity, and fineness of yarn, be woven ; let the first be plain and the second tweeled, and their strength ought to be the same. But if by *strength*, we understand that property which opposes the most effectual and most continued resistance to the decay of cloth, from common wearing, the tweeled web (if equally used) would be in tatters long before the plain one would be materially injured. This is the idea commonly, although inaccurately, attached to the word strength when applied to the texture of cloth ; and, indeed, the above remark will not be found universally true, for the durability of cloth exposed only to common wearing, depends partly upon its strength, and partly upon its flexibility.

It is not, therefore, in the effect of the mechanical operation, but in the facility of combining a greater quantity of materials in the same space, which this mode of weaving affords, that we are to look for superior strength or durability. This may be easily illustrated : when the shed of any web is opened, every thread of warp, either above or below the thread of weft, will oppose a certain resistance to the operation of the reed in driving the weft thread home, and the sum of all these will be the total amount of resistance. Now, in plain weaving, as before stated, every thread is alternately interwoven, and therefore, opposes its portion of resistance ; whereas, in a *four leaf tweel* every fourth thread only is intersected, and of course, less resistance is given. The ratio of resistance, therefore, will be *inversely*, in proportion to the number of leaves of headles in the tweel.

In the warp the friction on the reed will be diminished, in the same proportion ; for each warp thread, instead of changing its place every time the weft thread crosses, changes only once every four times ; consequently, much more warp may be crowded into the same space than could be done in plain weaving.

From the above we may safely deduce, that the strength or durability of a tweeled web, will be somewhat less than the proportion of materials it contains will be to that of a plain web, supposing each to be of equal strength and quality.

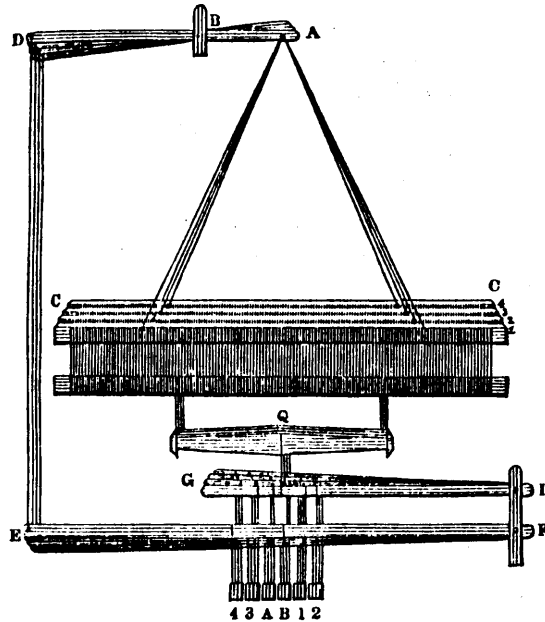
But when the fabric is very close, tweeled cloth possesses another advantage over plain in point of durability. When the warp of plain cloth is very much crowded in the reed, and the weft driven very closely up, the threads, in order to cross each other alternately, must deviate very considerably from a straight line, whereas, when woven they become serpentine. This renders the cloth very liable to be easily cut or chafed, especially when composed of hard and comparatively inflexible materials, such as flax; and the defect is chiefly observable in stout linens. But in tweeled cloth, as the threads only cross at intervals, the deviation from the straight line is much less, and the flexibility of the cloth, of course, much greater.

The same general remarks which have been given in the first section, apply almost equally well to the operations of the weaver in all descriptions of work. The varieties consist, chiefly, in the modes of arranging the loom, so as to enable the weaver to produce the desired effect.

MOUNTING OF LOOMS FOR TWEELING.

As almost every variety of fancy weaving is produced by the order and succession in which the weft is interwoven with the warp, the principal difference in *mounting* the looms is in the number and arrangement of the leaves of the headles, and the apparatus for moving them. In weaving plain cloth, the jacks represented in Fig. 8, at FF, answer the purpose sufficiently well, because the raising and sinking of every thread is alternate. But, in the weaving of tweels and many other kinds of ornamental and fancy cloth, the number of leaves is generally greater, and these are to be raised and sunk successively, or not, as the nature of the case may require. It is therefore necessary, that the mounting of the loom should be adapted to the purpose for which it is intended, and as the succession of working the headles by means of the treadles may frequently vary, the mounting which connects every leaf with the treadle, and from which its motion is derived, must be such that the leaf may be raised or sunk independent of all the others. A representation of the mechanism used for this purpose, by many skilful weavers, will be found in Fig. 15.

Fig. 15.



In this figure *four* leaves of the headles are represented at C, perpendicularly above which are *four* levers, moving upon centres at B. From one end of each of these levers at A, a leaf of the headles is suspended by the two *oblique placed* cords: these cords meeting below the lever, continue as a single cord to pass through a groove in its end, and are then made fast to it. Below the headles are two sets of *marches* or levers, consisting of four each, which are moveable at the centres F and I. The long marches are distinguished by the letter E, the short by G. Each of the four long marches is connected with the end of the corresponding top levers at D, each short march is connected with the lower shaft of the leaf of the headles to which it is to give motion.

Now, as each of these marches is connected with one leaf of the headles, it follows, that if a *long* march is pulled down, the leaf will rise; if a short is pulled down, the leaf will sink.

This will be apparent, when it is considered that the cords below form a direct connexion between the *lower* headle shafts and the short marches. Of course, when one of the latter is pulled down, those of the former, with which it is connected, must sink also. But the motion communicated from the *long* marches to the upper shafts is reversed at the centre of the top levers; for when the end

D is pulled down, the end A will rise, and the corresponding headle leaf will be pulled up. These top levers are known among weavers by the name of *coupers*.

The arrangement of this apparatus, although very simple, ought to be carefully studied by those who are not conversant with the practice of weaving, for it is very generally used, in almost every species of ornamental work. The ends of the top levers or *coupers* at A, which contain the grooves for the suspending cords, ought to be segments of a circle, the radius of which is equal to the distance of the groove from the centre of motion at B, in order that the pull may be uniformly perpendicular. The distance of the centre B from the end D is, generally, made twice as great as that from A to B, for otherwise the long marches would communicate too great a range of motion to the rising headles. If greater accuracy is wanted, the ranges of the different levers, and the ratio which they bear to each other, may be calculated by the same rules which apply to all other motions communicated by means of levers, and these are explained in almost every elementary treatise upon mechanics.

When the connections between the headles and marches have been formed, agreeably to the above description, it is only necessary to arrange the treadles, and to connect each with the marches which it is intended to move.

It is a common rule in fancy weaving, that every individual treadle should be connected with all the leaves of the headles, for the purpose of raising some and sinking the rest. Some exceptions to this rule however, occur; but these are few, and will be particularly noticed, when the cases to which they relate are being investigated.

The connecting cords between the marches and treadles are applied in the manner proper for weaving a web which may be tweeled or plain. This kind of mounting is often used for cloths *in which the ground is woven plain, and stripes tweeled by the weft, occasionally introduced*. If the figure is carefully examined, the connection of each treadle with the marches may be easily distinguished by comparing the lines which represent the cords, with the description which will be afterwards given.

But previous to this, it may be useful to explain the mode of drawing plans upon paper to direct the weaver in drawing his warp through the headles, and of applying the cords by which these headles are to be worked; these plans are generally called the

DRAUGHT AND CORDING.

Plans of this description may be considered as horizontal sections of a loom, for the purpose of showing the headles and treadles. Although the treadles of a loom are placed directly under the headles, it is usual to represent them at one side, upon the paper, or draught, for the sake of easier reference from the one to the other.

Fig. 16.

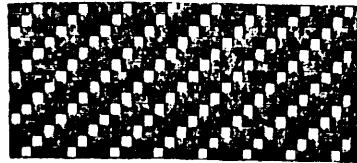
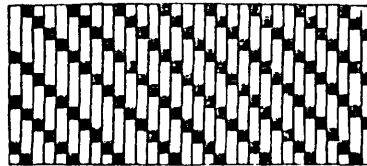


Fig. 17.



Figs. 16 and 17, are representations of tweels of four leaves, and as the fabric of tweeled cloth is generally thick and close, they, being on a large scale, will convey a clear idea of its appearance, as they are designed to give an accurate representation of the intersections of the threads. If we suppose that the warp of a tweeled web is of white yarn, and that the weft is black, Fig. 16 will convey a correct idea of the appearance of the upper side of a web when woven in a loom mounted with four leaves of headles, every fourth leaf being raised and three sunk; and Fig. 17 will represent the appearance of the under side of the same web; for in Fig. 17 the white warp appears flushed, and in Fig. 16 the black weft is flushed. Now, were the cording reversed, that is to say, were three leaves to rise and one to sink when each treadle is pressed down, the effect would be quite the same, excepting that the upper side would then be flushed by the weft, as in Fig. 16 and the under by the warp, as in Fig. 17. This reversing of the flushing, which may be effected by additional mounting, is the principle upon which the ornamental figures upon many kinds of tweeled cloth depends.

We shall have occasion to treat of this hereafter.

ARRANGEMENT OF TREADLES.

When a great number of treadles are necessary to produce any effect, it will be obviously the best way to arrange them in the succession in which they are to be pressed down by the weaver's foot, or feet, when this is practicable. For if some regular order be not adopted, the weaver will frequently be apt to mistake the treadle and press down a wrong one. In heavy fabrics, where great power must be applied, the weaver is generally obliged to use both his feet on the same treadle, as well as the whole weight of his body. In this case it is common to place the treadles in regular succession from right to left, as—

6—5—4—3—2—1.

But when the fabric is lighter, and when the pressure of one foot is sufficient, it will be more convenient to arrange the treadles so that the right and left foot may be applied alternately, without crossing each other. When this is the case, the weaver, while treading with one foot, has sufficient time to shift the other to the next treadle, without impeding the operation. This naturally leads us to commence our succession at the centre, and to place the succeeding treadles alternately upon each side, as—

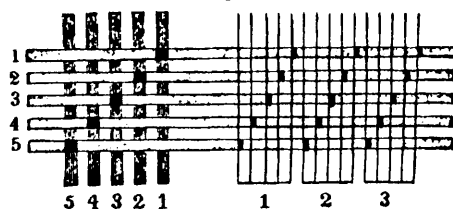
5—3—1—2—4—6.

In this case the treadles 1, 3, and 5 will be wrought by the left foot, and the treadles 2, 4, and 6 by the right; and by applying the feet alternately, the treadles from 1 to 6 will be wrought in the regular order adopted in the elevation Fig. 15.

In Fig. 15, four treadles are required for the tweel and two for working the web plain. The former are distinguished by numbers, the latter by the letters AB.

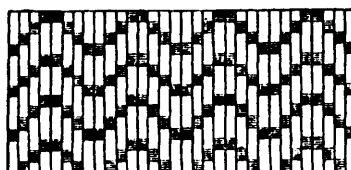
In all the plans given it is to be understood that when two treadles are applied for the purpose of working the web plain, these treadles are always distinguished by the letters AB. All treadles for the fancy part are distinguished by numbers, and the placing of these numbers gives the order in which the treadles ought to be wrought. Fig. 18

Fig. 18.



shows the draught and cording of a loom, mounted for working a tweel consisting of five leaves of headles. The only difference between this and the four leaf tweel is in the number of the leaves and treadles. The drawing of the warp through the headles proceeds in the same regular succession from right to left, and the treadles are arranged in the same order. In Fig. 18, five of the lines which represent the threads of the warp are connected by each cross line, five threads therefore are to be drawn through each interval of the reed. Fig. 19

Fig. 19.



represents a kind of ornamental tweel, produced, merely, by reversing the order in which the warp is drawn through the headles. The plan for drawing and cording a web of this description will be found by referring to Fig. 20.

Fig. 20.

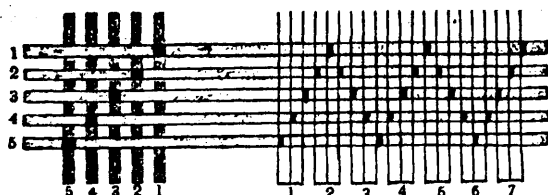


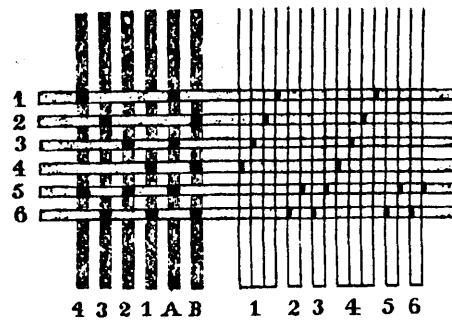
Fig. 20 is the cording of a tweeled stripe, where the tweeling is reversed in the draught, in a way similar to that shown in Fig. 19. Stripes of this kind are called by weavers *herring bones*, from their resemblance to the back bone of that *native* of the deep. The draught and cording will appear by inspection, if the explanations already given are fully understood.

We have hitherto considered all the threads of warp in tweeled cloth, as interwoven in progressive succession, for the sake of rendering the general principle of tweeling more obvious to those *previously unacquainted* with this branch of weaving. When tweels do not exceed four leaves, this arrangement is always adopted, but when a greater number of leaves is used, a kind of alternate succession is esteemed preferable: this is called by weavers

BREAKING THE TWEEL.

When a tweel consists of many leaves, the *flushing of both warp and weft* would be so great, that the intervals between the points at which they are interwoven would necessarily be very flimsy, (as in many kinds of French fancy vestings) and the fabric very unequal. To obviate this inconvenience, the broken tweel is used. The same mounting by which a regular tweel is wrought, will also work a broken tweel by treading in different succession. But this would derange the order of the treadles, and, as mentioned before, might be productive of many mistakes. Weavers therefore prefer placing the cording so that the regular succession of the treadles may be preserved, while the effect of the broken tweel is at the same time produced. An example of each of these follows: The first, Fig. 21,

Fig. 21.



is a plan for mounting a loom, so as to produce both plain and tweeled cloth at the same time. Such plans are generally adopted, when it is requisite to weave webs, the grounds of which are to be plain, and the stripes tweeled by the warp. Two treadles are added, to enable the weaver to work the whole fabric plain, if necessary. If not required, the two plain treadles A B may be omitted. In this plan, the leaves 1, 2, 3 and 4 contain that portion of the warp which is to form the tweeling or stripes, the leaves A B, that portion which is to form the ground or intervals. An examination of the mode of applying the cording will evince that when the treadles 1, 2, 3 and 4 are pressed down in the order of the numbers, the tweeling leaves 1, 2, 3 and 4 will rise successively, and the plain leaves A B alternately. The draught of the warp through the reed, as denoted by the cross lines, is here adapted to the purpose of rendering the tweeled stripes more close and compact than the plain ground; for of the former four threads pass through each interval,

and of the latter only two. But if the whole is to be wrought plain, occasionally, the entire warp should be equally drawn through both the headles and reed. This case very rarely occurs. Fig. 22 is a plan of a plain and tweeled stripe, and Fig. 23 is its draught and cording.

Fig. 22.

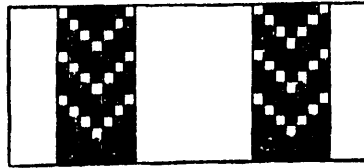


Fig. 23.

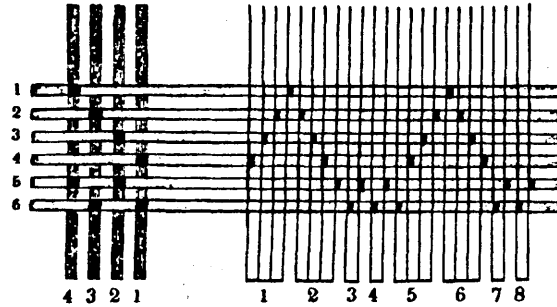


Fig. 24 is a regular five leaf tweel, the same as Fig. 18. Fig. 25 is the same tweel broken; and the succession of the treading, to produce either the regular, or broken tweel, is expressed by the numbers annexed to each.

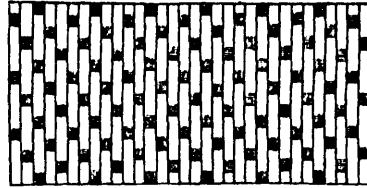
Fig. 24.

Fig. 25.

1						1						1
2						2						2
3						3						3
4						4						4
5						5						5
R	5	4	3	2	1		B	5	4	3	2	1
B	3	5	2	4	1		R	3	5	2	4	1

The above example will sufficiently show the two ways of tweeling: and also that the whole difference in the cording is solely to preserve a regular order in the treadles. The same succession of treading which breaks the tweel in Fig. 25, restores its regularity in Fig. 24. In these, and the following examples, each interval between the lines denotes a leaf of the headles. Numbers are used to show the order and succession in which the threads are drawn, and the dark squares denote the raising cords; which squares we prefer to use instead of cyphers, as they are more like design paper.

Fig. 26.

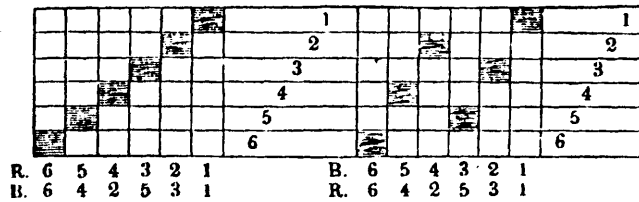


is a specimen of the effect and appearance of a five leaf tweel, broken in this way, as viewed on the side where the warp is flushed. In the same way, tweels of six, and seven leaves are drawn and mounted. The following are examples of each :

SIX LEAF TWEELS.

Fig. 27.
Regular.

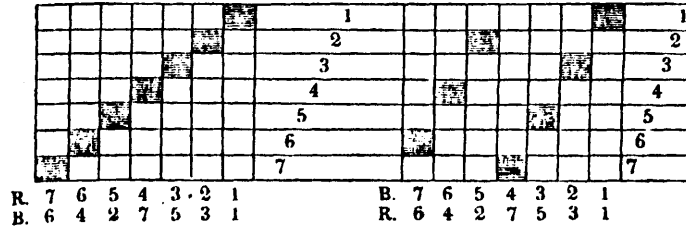
Fig. 28.
Broken.



SEVEN LEAF TWEELS.

Fig. 29.
Regular.

Fig. 30.
Broken.



These examples will show the manner of forming the alternate or broken tweel. It is to be observed that the cording may be adapted in various ways, and the tweel broken in several places, according to the discretion of the weaver. When the number of leaves will admit of it, the succession should be made, as nearly as possible, at equal intervals. For example, in the broken tweel of six leaves, (shown in Fig. 28,) all the leaves ought to follow each other in succession, passing one leaf between each until you come to the sixth treadle, but as the first treadle immediately follows the

sixth in repeating the operation, there will be no interval there; and the effect of these two leaves will be that of a regular tweel, while all the rest give that of a broken tweel. There is also an interval of two leaves between the intersection produced by the third and fourth treadles.

This, however, cannot be avoided in working with six leaves; this number, therefore, although given as an illustration, ought to be avoided in practice. The five leaf tweel also, though much used, has an interval of two leaves between the third and fourth treadle.

When eight leaves are employed, the succession in breaking the tweel is different, and disposes the warp at intervals more perfectly than any tweel that can be formed by a smaller number of leaves.

In all the former, the interval is formed by passing one leaf between every two until the whole are corded, but in the eight leaf tweel two leaves are omitted, and the third has the raising cord applied, as will be seen by the following example, Fig. 31.

EIGHT LEAF DAMASK TWEEL, OR HALF SATIN.

Fig. 31.

								1
								2
								3
								4
								5
								6
								7
								8
Broken.	8	7	6	5	4	3	2	1
Regular.	6	3	8	5	2	7	4	1

It is unnecessary to give further explanation of the eight leaf tweel, because it proceeds exactly like those already given; besides, with so many leaves, regular tweeling is seldom used. By examining this cording it will appear, that the intervals by which the tweel is broken are perfectly regular, for the first treadle succeeds the eighth at the same interval as all the others.

It is to be observed of satin tweels, that some are perfect in respect to the intervals at which the leaves can be raised, and others are imperfect. When the leaves can be raised regularly at intervals of one, two or more from each other, the tweel is said to be perfect; but imperfect when the number of leaves does not admit of this arrangement. The lowest tweel that can be broken is that of four leaves, which is usually called the *satinett* tweel.

The last specimen of common tweels which we shall give, is that

of sixteen leaves, and is only to be found in some of the very fine Chinese, Italian, French and English silk fabrics. Here the tweel is broken by omitting four leaves and cording the fifth.

SIXTEEN LEAF, OR FULL SATIN TWEEL.

Fig. 32.

																					1	
																						2
																						3
																						4
																						5
																						6
																						7
																						8
																						9
																						10
																						11
																						12
																						13
																						14
																						15
																						16
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1							

Having finished our observations, for the present, on this part of our subject, and given such examples as appear necessary to convey a sufficient knowledge of the principles of common tweeling, of the varieties of which it is susceptible, and of the machinery requisite for weaving the various kinds, our next object is to investigate the means by which looms are adapted to the weaving of

TWEELED STRIPES.

In the references to Figs. 16 and 17, the flushing upon tweeled cloth has been explained. *On one side the warp is flushed, on the other the west.* Most kinds of fancy tweeled stripes are produced by the application of this principle.

Stripes upon tweeled cloth differ from those upon plain in the following respects: tweeled stripes may be formed without any distinction in the fineness of the warp; nor do they require super-numerary threads to be drawn either through the headles or the reed, it is only requisite to flush the warp and west alternately.

The examples necessary to illustrate this are upon the scale of a five leaf tweel; for the same principle will apply to any number of leaves used for tweeling.

FIVE LEAF TWEEL STRIPE.

Fig. 33.

Regular and Reversed.*

										1 1 1
										2 2 2
										3 3 3
										4 4 4
										5 5 5
										1 1 1
										2 2 2
										3 3 3
										4 4 4
										5 5 5
5	4	3	2	1						

The above is a specimen of a stripe upon ten leaves of headles, five of which flush the warp and five the west.

This stripe is produced by two sets of leaves, consisting of five each. The cording of the back set is exactly the same as the regular five leaf tweel, already described in Fig. 18 (which see;) that of the front set is the same *reversed*; in the back set there are five raising cords which raise one leaf successively, while all the rest sink, and there are also five sinking cords, as indicated by the blanks, which sink one leaf successively, while all the rest rise as in the front set. By this arrangement the back set flushes the west, the other the warp. The stripe is formed by drawing a portion of the warp through one set of leaves, then another portion through the other set, and so on alternately, according to the pattern of the stripe, which may be regulated by fancy.

It is usual in this species of tweeling to invert the order of raising the leaves of the two sets; for it will be obvious, that when the treadles are worked in the order from right to left, the back leaves will rise in succession from one to five, and the front leaves will sink in an inverted succession from 5 to 1.

If a broken tweel is preferred, the leaves are corded exactly as in common tweeling, *one set rising, the other sinking*. The following example will be sufficient:

* When one headle is lifted out of every five, in regular succession, the tweel is said to be *regular*; and, when four are lifted out of every five, it is called *reversed*. In the former case, four fifths of the west show on the upper side of the cloth; and, in the latter, four fifths of the warp. This explanation we give merely as an example, for these terms are applied to tweels of any number of leaves. Fig. 33. shows the tweel regular and reversed.

FIVE LEAF TWEEL STRIPE.

Fig. 34.

Broken and Reversed.

					1 1 1 1
					2 2 2 2
					3 3 3 3
					4 4 4 4
					5 5 5 5
					1 1 1 1
					2 2 2 2
					3 3 3 3
					4 4 4 4
					5 5 5 5
5	4	3	2	1	

All tweeled stripes are mounted upon the same principle. Any number of leaves may be adopted, as in common tweeling. The patterns depend *entirely upon the succession of drawing the warp through the leaves of the headles*, and may be varied almost to infinity.

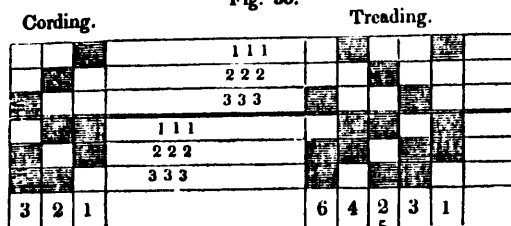
TURNED OR REVERSED TWEELING.

In all the regular and broken tweels the greatest proportion of the weft is thrown to one side of the cloth, and of the warp to the other. In a five leaf tweel, for example, *if the warp were one colour and the weft another*, and as there is always one leaf raised and four sunk, it will follow, that four fifths of the weft will appear on the upper side of the cloth and four fifths of the warp below. But, were the plan of this cording reversed, four fifths of the warp would be thrown on the upper side and of the weft below. Changing the appearance of the weft from one side of the cloth to the other in this manner is called *turning, or reversing* the tweel, (see Figs. 16 and 17) and is of very extensive application in different branches of weaving, particularly in *dimity, diaper, and damask*, which will be explained in their proper places.

Suppose, therefore, that a piece of cloth were to be woven in tweeled stripes, *one stripe the reverse of the other*, two sets of tweeling leaves would be necessary, and the plans of cording on the treadles would also be the reverse of each other. The first of these tweels, in respect to the number of leaves, is the *dimity cord*, which is merely the three leaf tweel turned, a plan of which is subjoined, both for cording and treading :

DIMITY CORD.

Fig. 35.



In the above plan the first nine threads of warp are drawn on the back set of leaves, and the other nine on the front set. Under the word cording, the raising marks are so placed on the back leaves as to flush or float the weft on the upper side of the cloth, and on the front leaves to throw up the warp.

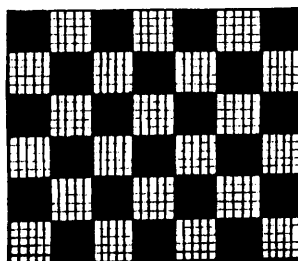
DORNIC AND DIAPER.

This branch of weaving was chiefly confined to the manufacture, of table linens, till of late that it has been applied to certain species of shawls, in the cotton manufacture, the warp and weft of which are, in general, of different colours. The coarser sets of table linens, and which require the least mounting, having only a four leaf tweel, were manufactured in considerable quantities, some time ago, at the village of Dornock, in the north of Scotland, whence the name Dornic: but the finer kinds which are usually woven by a more extensive apparatus, and in general with a tweel of five leaves are called diaper.

The most simple pattern of this kind is the damboard or checker as shown in Fig. 36.

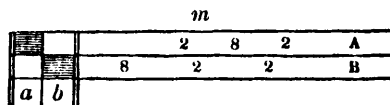
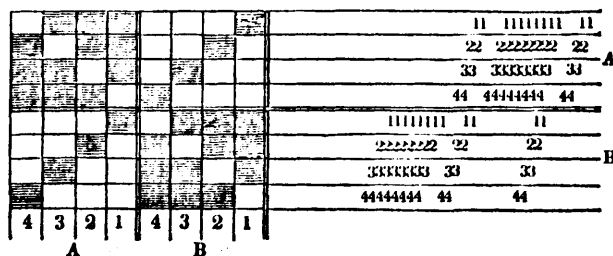
DAMBOARD OR CHECKER.

Fig. 36.



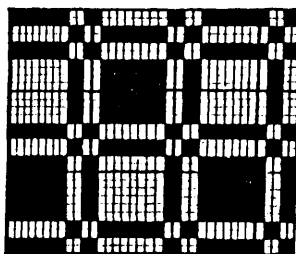
But such draughts, instead of forming squares, may be broken into an indefinite number of parts of various dimensions, and when the whole of this variety contained in one set of the pattern is woven square, which is effected by following the same order of succession in treading, as is observed in the draught, or any other succession which fancy may suggest, an endless diversity of figures may be produced, merely by two sets of tweeling leaves. The following plan, Fig. 37,

Fig. 37.



which may be taken for an example, is the draught and cording of a very common pattern in this branch of weaving, and the figure which it produces is represented on design paper in Fig. 38.

Fig. 38.



This draught and plan of cording are adapted to the four leaf regular tweel, the cording being the same as the checker (Fig. 36 :) but it will be obvious, from the examples given under the article tweeling, that the same figure may be produced by a tweel of any other number of leaves, and woven either by the regular or broken method of treading.

When two or more sets of tweeling leaves are thus employed, the mounting is said to consist of two or more *divisions*, (each division generally contain four leaves of headles) and the draught and cord-

ings of such mountings are usually marked on one leaf and treadle for each set or division which are sufficient to exhibit all the design. This is called the *binding plan*, because it binds, as it were, the several divisions together which are at any time to be raised, and brings all that is essential in the pattern into a small compass; so that the weaver has only to substitute one set of tweeling leaves and treadles, whatever number may be employed, for each leaf and treadle in this plan.

This will be apparent by comparing the preceding draught and cording (Fig. 37,) with the corresponding draught and cording on two divisions, (each of which represent four leaves) marked, *m*, in which it will be observed, that on the back set of the leaves A, there are two draughts, which are marked 2, then 2 over the fore set B. These are succeeded by eight draughts on the set A, two on the set B, two on the set A, and eight on the set B; all of which are set down in figures, respectively, on the binding plan *m*.

Where the four treadles A cross the leaves or divisions marked A, the greatest portion of raising marks is placed, or that division is said to be raised in order to reverse the tweel: a raising mark is therefore placed in the corresponding square of the binding plan on the treadle marked *a*, the same is to be observed with respect to the leaves and treadles marked B (Fig. 37,) and this takes place in all those plans which are given in the contracted form, whatever number of divisions they contain.

In weaving this pattern, the weaver works twice over the treadles A, because these reverse the tweel in such parts of the pattern as are represented on the back division, and by following the succession of the draught, he goes twice over the treadles B, eight times over the treadles A, and so on, till the figure be square, after which the same succession is repeated.

When dornic or diaper patterns are drawn on design paper, which is usually 10 by 10, each black square in the binding plan denotes one space by the warp, so that each of these spaces may contain sometimes four, and sometimes five threads, according as it is intended for dornic or diaper, or fineness of the reed. The spaces by the weft likewise contain a corresponding number of picks, or once over the set of headles.

Keeping still in mind the general rule, that all patterns formed by the warp are produced by the raising cords, let the warp in this example be supposed blue, and the weft white, then the dark shaded spaces in the figure will represent the pattern as formed by flushing the warp above, and the white spaces, those parts of the pattern

where the warp is underneath. Hence the two spaces at the bottom of the design (Fig. 38,) will represent those parts of the figure which are produced by working twice over the treadles A, the next two spaces those that are produced by the treadles B; the treadles A, again being wrought eight times over from the large squares of eight spaces each way, and so on with any other variety that may occur, without any regard to the number of tweeling leaves in the division.

It must be observed however, that this pattern is drawn upon a comparatively small scale, and thus in applying such patterns to practice, they may be enlarged in any given proportion, either to expand their dimension or to suit them to any desirable set of reed; thus were all the figures on the plan, *m*, multiplied by 3, the draught would stand three times the size it now is, and so of any other pattern.

When a still greater variety of pattern is required, the number of divisions must be increased as in the other branches of weaving; as these mountings, however, can only be augmented by adding complete sets of the tweel, the varieties arising from an increase of leaves in this, must be more limited than in almost any other branch. This disadvantage however, is in a great measure compensated by the ingenious diversity which is usually observed in the succession of the draught, by means of which a style of pattern peculiar to diaper weaving is produced. The same draught, also, will weave a variety of patterns, agreeably to the different arrangements of the raising cords upon the binding plan, and the succession of working over the treadles; and that diaper mountings may not always be confined to their original draughts, the headles are not, in general, spaced like common power loom, or other headles, but are cast separately, as in the finer kinds of fancy mountings, so as to run upon the backing or *muddling* cord, by which the weaver can adapt them, at pleasure, to any pattern he may have occasion to weave. The following plan, Fig. 39,

Fig. 39.

					1	2	2	1	3	3	1	2	<i>d</i>
					1	1	2	2	1	1	1	1	<i>c</i>
					1	1	3	3	1	1	1	1	<i>b</i>
					1	1	4	1	1	1	1	4	<i>a</i>
1	1	1	1	1									
2	2	3	4										
2	2	3	4										
1	1	1	1										
3	1	1	1										
3		3											
4c.	1												
<i>d</i>	<i>c</i>	<i>b</i>	<i>a</i>										

Binding Plan and Treading.

which is on a scale of four divisions, and only a four leaf tweel, for saving room, will give the reader an idea of the manner in which a variety of patterns may be obtained from the same draught and succession of treading, merely by a different position of the raising cords upon the treadles.

SECTION THIRD.

WEAVING DOUBLE CLOTH.

THE next variety of weaving that claims our attention, is that of double cloth, which is for the most part composed of two similar fabrics (generally plain) interwoven at various intervals, and formed into a diversity of figures, agreeably to the design of the pattern to be produced. This is the method usually practised in ingrain carpet weaving (which see.)

In order to render this species of weaving as perspicuous as possible, let us take, for example, the warp of any plain fabric one thread of which is blue and the other white, alternately, and let us suppose this warp to be drawn through a common four leaf set of plain headles in the usual way. These headles might be worked to produce the following changes of fabric :

1st. When the two back leaves are raised and sunk alternately with the two fore ones, and white weft thrown across, the whole fabric, which is plain cloth, will be formed into very small blue and white stripes, and if a pick of blue and a pick of white be thrown in alternately, a corresponding check will be produced.

2d. If the two fore leaves were constantly sunk and the back ones raised alternately, it is plain, that by throwing in blue weft, all the blue warp would be woven into a uniformly blue fabric, leaving the white warp unwoven below.

3d. Were the two back leaves constantly raised and the two front ones raised alternately, a white fabric would be produced by throwing in white weft, leaving out the blue warp above.

Hence, if one shuttle only were employed for both webs, so long

as the weaver continued to work upon one set of treadles, the two webs would still be distinct, except at the selvages, where they would be united by the weft.

It was in this manner that Ichao he-he-hi-ho Ouang (nephew to Teling Ouang, emperor of China, who reigned 1079 years before Christ,) manufactured hempen pipes, for conducting water to his uncle's flower gardens. Pipes, woven in the same way, have been lately adapted, in France, to the fire engine, and also as wicks for the patent lamps. It was likewise on this principle that *Julius Cesar's great coat* was woven.

TWEELING DOUBLE CLOTH.

Although tweeling, however extensively it may be otherwise employed, is seldom applied to double cloth, yet as there is great room here for a display of ingenuity, especially in the manufacture of shawls, plaids, bed covers, &c., it will be necessary to show how the several varieties of this kind of texture may be produced.

It has been already observed that four leaves of headles, two for each set, are required to weave double cloth of the plain texture. If, therefore, one set of tweeling leaves be substituted for each set of plain ones, it will be obvious, that every variety of pattern that can be produced on the plain texture, can likewise be effected on the tweeled one.

For example, take six leaves, enter orange warp in the back three, and red warp in the front three. It is evident that if the back set be worked, a three leaf tweel can be produced by lifting one leaf in regular succession until three picks of weft be thrown into the web, and thus, supposing the weft to be orange, cloth of that colour will be produced, entirely independent of the red warp in the front leaves.

Again, by working the front leaves exclusively of the back ones, a red fabric will be produced, *provided the weft be red*; and if these two webs be made to pass through each other at different intervals, various devices and patterns may be produced. (See in-grain carpeting.)

This mounting makes one web entirely orange and the other all red, but if the two colours of weft be different from the warp, then we may throw the greater proportion of either one, or both warps, outward, or inward, and thus a variety of colours may be displayed.

As it would, however, require a great number of leaves of headles,

and treadles to weave but a very limited pattern on this principle, this style of work seems to be peculiarly adapted to the draw-loom, under which head the subject of tweeling double cloth will be further illustrated.

THE JUNCTION OF TWO UNEQUAL FABRICS.

This species of double cloth is chiefly confined to *quiltings*, commonly called Marseilles quiltings, which are also manufactured in considerable quantities in Great Britain, and printed for vestings.

The mounting of a quilt consists of a set of plain headles, usually four for the face, and a number of stitching leaves proportionate to the range of the pattern for the back, and these produce all the variety of figure in the design. The stitching leaves are frequently adapted to diagonal and diamond patterns, although they may be made to produce any other fancy figure at pleasure, and the range of pattern, as in other branches of ornamental weaving, may be enlarged beyond the power of leaves, or until the application of the draw loom becomes necessary.*

Quiltings are generally woven in reeds of the Manchester and Bolton count, which contain a certain number of beers or porters in $24\frac{1}{4}$ inches. The warp and weft of the face are considerably finer than those of the back, and two threads of the face and one of the back are drawn into the same interval or split of the reed. If we take, for example, a No. 36 reed that is 36 beers in $24\frac{1}{4}$ inches, the warps and wefts as noted below will make a pretty good quilt :

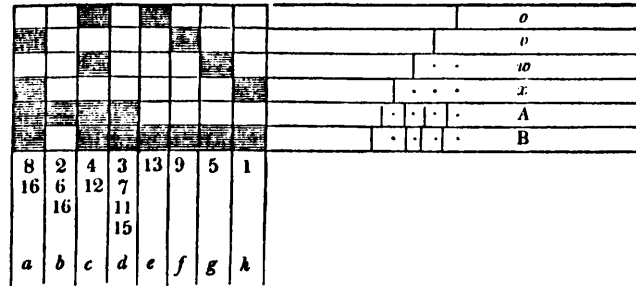
For the face No. 36.	}	warps.
For the back 26.		
face 46.	}	wefts.
back 36.		

In weaving these fabrics, there are two picks of the fine and two of the coarse weft thrown in alternately. One pick of the fine stitches the back and face together, and one of the coarse is thrown in between the back and the face clear of both fabrics, and this is called the wadding. The other coarse pick goes into one of the sheds that work the back, so that when eight picks of weft are thrown, four go to the face, two for wadding, and two are thrown into the two alternate sheds of the back. The following plan (Fig. 40) will show the construction of a quilt mounting.

* The late Mr. David Anderson, Damask Manufacturer, Glasgow, wove a shirt with a fine frill, double stitched neck, shoulder straps, and wrist bands; also gussets, buttons, button holes, &c. with the Royal Arms emblazoned on the breast.

DIAGONAL QUILT.

Fig. 40.



In the above plan A and B are the two leaves for the face, and *o*, *v*, *w*, *x*, the stitching or back leaves. The treadle *b*, opens one shed of the face, and sinks all the warp of the back, and this treadle works alternately with the treadles *e*, *f*, *g*, *h*, which open the other shed of the face and at the same time raise each of the back or stitching leaves. The treadles *a*, and *c*, open the two sheds of the back, while at the same time they raise all the warp of the face above the shuttle. The treadle *d*, opens the shed for the wadding, by raising the face and sinking the back.

By tracing over the figures that point out the order of treading it will be found that the first and second picks, which are fine, are thrown into the face, but at the first tread the stitching leaf, *x*, is raised, by which the back and face are tacked together. The third and fourth picks are coarse, the former goes for wadding and the latter is the first shot of the back. The fifth and sixth picks are fine, which are wrought into the face, but the former has the back leaf, *w*, raised, by which the back is again stitched to the face. The seventh and eighth picks are coarse, the former goes for wadding, and the latter forms the second pick of the back: and thus any pattern may be woven at pleasure, according to the succession of the draught on the stitching leaves, and the order in which they are raised.

Although the preceding plan is given in the most concise form of which it is susceptible, in order to render the principles of this species of weaving as perspicuous as possible, yet in practice the weaver will find it very awkward to shift his right foot from each of the stitching treadles to the wadding one, while his left is engaged with a different succession with the others. To obviate this, a wadding treadle with the same cording is usually placed alternately with a stitching one, by which arrangement the succession of treading for the right foot will be in a regular or progressive

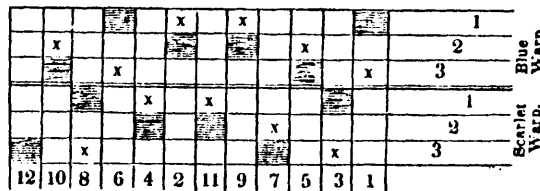
DOUBLE CLOTH HARNESS.

Having already explained the principle on which double cloth is woven, it only remains for us to show how that principle is extended to the draw loom.

Suppose we take a shawl for example, the pattern of which is scarlet and the ground blue, the warp of course will be composed of a blue and scarlet thread alternately; and suppose two threads of each colour to be drawn through each mail of the harness. Were the texture to be that of a three leaf tweel, six front leaves, three for the blue and three for the scarlet, would be necessary, and twelve treadles would be required to make the treading alternate. A four leaf tweel, however, would require eight leaves of headles and only eight treadles. The following plans will show the draught and cording of these mountings:

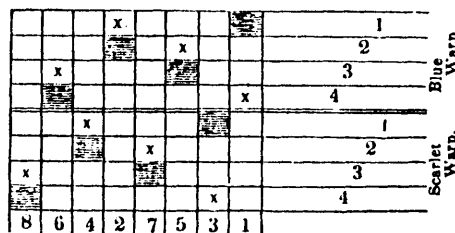
THREE LEAF TWEEL.

Fig. 45.



FOUR LEAF TWEEL.

Fig. 46.



In these plans the crosses X represent sinking cords, and the black squares raising cords.

In weaving these shawls two picks of blue and two of scarlet weft are thrown in alternately, the two former on the fore warp, and the two latter on the back warp.

VELVETS.

This species of manufacture having never been introduced into America, *where consequently it can be but little known*, some account of it will not, perhaps, be uninteresting to the reader.

In these, as in some other branches of fancy weaving, considerable ingenuity is displayed in the production of patterns, which in general exhibit a variety of flushing or floating peculiar to themselves. This will be obvious from a perusal of the specimens subjoined to these descriptions. The ground, or *back*, as it is generally termed, is sometimes plain, and sometimes tweeled. In the former case it is called a tabby or plain back, and in the latter, a jean or Genoa back, and the jeans are single or double, according as they are woven in a three or four leaf tweel mounting. The flushing, which is afterwards cut up to form the ridges or the pile, is thrown in and interwoven with the ground at various intervals, and upon this depends all the diversity of patterns which we see in these fabrics. A few examples will illustrate these observations. Fig. 47 is a

PLAIN OR TABBY-BACK VELVET.*

Fig. 47.

						3	1
						5	
							2
						6	4
6	4	2	3	1			
		5					

If we examine this plan we will find that the treadle marked 1, or the first in the order of treading, will raise all the odd threads 1, 3, 5, in the draught, and the treadle marked 4 will raise all the even ones; consequently, these two treadles wrought alternately will produce plain cloth, or in other words, they will work the ground or back. The other three treadles are for the flushing. By tracing over the treading of this figure, it will be found, that there are two picks of the flushing thrown in for each pick of the ground, which are marked 2, 3, 5, 6, in the succession of treading; the treadle 6, being the same as 3, is added merely to keep the treads alternate when both feet are employed on the treadles.

The following plan, Fig 48, is an example of a

* When figures are to be formed on velvets, agreeably to any particular pattern, recourse must be had to the Jacquard, or draw loom. See Gilroy's loom mountings.

SIMPLE JEAN BLACK VELVET CORD.

Fig. 48.

						1
						2
						3
						4
						5
						6
8	6	4	2	3	1	
12	14	7	5	11	9	
	10	15				
	13					
	16					

In this plan the treadles on which the figures 1, 3, and 6 are marked, are for weaving the back, it being the single jean, or three leaf tweel; but as each pick of the flushing weft floats over five threads of warp, and is only interwoven with the sixth, two sets of tweeling leaves are necessary in order to extend the draught to that range. In the present example we also find, that there are ten picks of flushing weft thrown in for six of the back, and these ten picks are interwoven with the warp threads 3 and 4 in the draught, and the flushed space afterwards cut up by the plough or lance.

PLUSH VELVET.

Plush velvet, or shag, is woven on a principle something different from any of the preceding fabrics. It consists of two warps, one called the main warp or ground, which is commonly made of hard silk, and the other the pile warp. These warps are beamed on separate rollers, the latter being placed below the former.

When the heading or end of the piece is woven, the weaver raises the pile warp, which is drawn on a separate leaf from the ground, and into this shed he introduces a wire which is longer than the breadth of the cloth; a few picks of the ground are woven (generally two) and another wire introduced, and so on with a third wire. In each of these wires is a groove, along which the weaver runs the point of a sharp instrument called a *trivet*, which cuts the pile, and relieves the wires in succession, and the operation is repeated till the piece is finished. The pile warp is commonly made of softer silk than the main warp, or of a fine kind of goat's hair, and the surface of the shag is afterwards cut evenly and smooth with a pair of shears, or a revolving spiral knife. On this principle is woven that fabric of which hats are made.

SECTION FOURTH.

WEAVING CROSSED WARPS.

THE species of ornamental weaving which we have now to investigate, is exclusively adapted to the slightest and most flimsy textures.

Like the other branches of the art, we derived our first knowledge of cross weaving from the East ; but, it certainly has been much improved, and a considerable variety of nets have been added, by the invention and ingenuity of European weavers.*

* Of course we include amongst these ingenious men, our very learned brother weaver, Dr. Ure of London, a man who has not only studied the manufacture of "*textile fabrics*" to perfection, in all its bearings, but who also, we doubt not, is well acquainted with "*Mason on Self-Knowledge*."

We have observed one fact, however, which is not very honorable to this weaving son of Galen. Surely it could not have diminished the Doctor's fame, although he had given to the public the names of those authors, from whose books he extracted whatever little information he furnishes to the ignorant, particularly upon *weaving*. He does not even allude to the work of the late Mr. John Duncan of Glasgow, from which he has taken most of the observations on weaving, contained in the second volume of his "*Cotton Manufactures*," commencing at page 264. We refer the reader to Duncan's treatise, which was published at Glasgow, in the year 1807. Nearly all the rest of the Doctor's remarks on weaving, he has adapted from Murphy's bed-quilt book, which he (the Dr.) calls "*a most luminous work*." We suppose that this puff entitled him to copy indiscriminately from Father Murphy, who could be no Irishman, unless he made some sacrifice in return for such *blarney*.

On another occasion, the worthy Doctor says, that Sharp, Roberts & Co., are "the greatest power loom builders in the world, without exception," and that "their *patent loom* is the best in use." These sweeping assertions, however, may be accounted for, when we know, that these mechanics furnished the Dr. with drawings and specifications of their *celebrated loom*, no doubt expecting that he would give it a first rate notice. But we in this country, and every experienced weaver in England know, that the power looms of Messrs. Sharp, Roberts & Co. are far inferior to many others, as we shall show in the course of this work, and any practical weaver who has conversed with these makers upon the subject, *must acknowledge* that they are entirely ignorant of the real principles of weaving. But at present, with regard to the Doctor, we shall

"No further seek his merits to disclose,
Or draw his frailties from their dread abode."

The first branch of cross weaving, and of which all the others are only varieties, is

COMMON GAUZE.

In all the branches of weaving which we have hitherto considered, the threads of the warp, whether raised or sunk, alternately, or at intervals, remain always parallel to each other, and without crossing. But in gauze weaving, the two threads of warp which pass between the same dents of the reed, are crossed over each other, and twined like a cord at every tread. They are twined to the *right* and to the *left*, alternately, and each pick of weft preserves the twine which the warp has received. To produce this effect, it is only necessary that the warp should really be crossed at every second pick, for its return from the crossed to the open or parallel state gives the reversed crossing.

A representation of a mounting peculiar to gauze weaving will be found in Fig. 49, and a section of the web is shown under the same figure at A.*

GAUZE MOUNTING.

Fig. 49.

Open Shed.

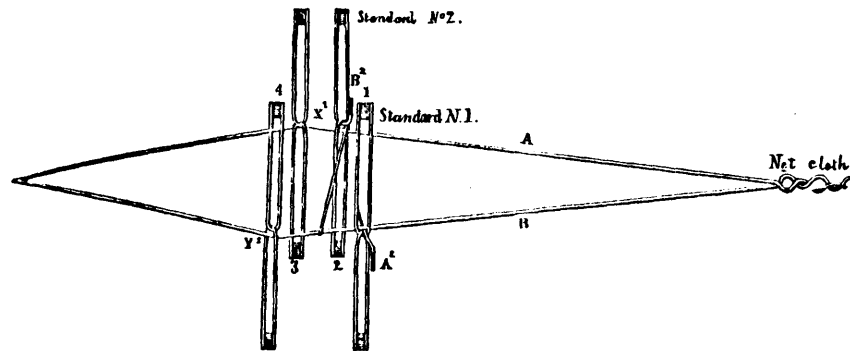
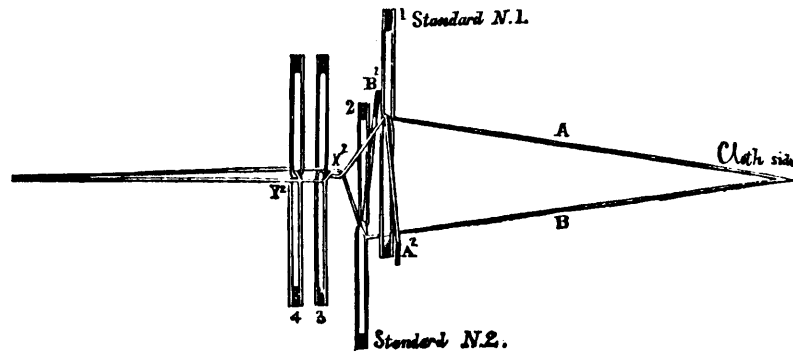


Fig. A.*



Fig. 49 represents two threads of warp opened to form the shed, where the warp is not crossed, and Fig. 50,

Fig. 50.
Crossed Shed.



the shed where it is crossed. The mounting of a gauze loom consists of four leaves, constructed like common clasped headles, and of two half leaves. The leaves are raised and sunk, by means of top levers or couplets, and marches, exactly in the same way as in most other ornamental looms. The opened shed of the gauze is formed by the leaves 3 and 4, (see Fig. 49) the cross shed by the leaves 1 and 2, and by the half leaves. The leaves 1 and 2 are called standards, and the half leaves pass through them, as is represented more clearly in Figs. 51 and 52.

Fig. 51.

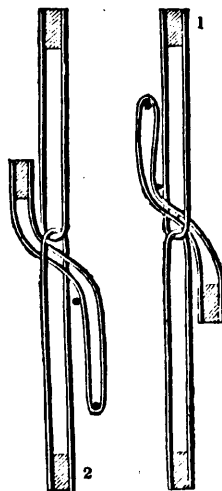
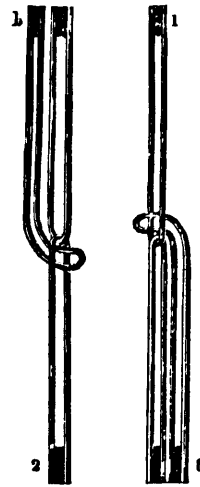


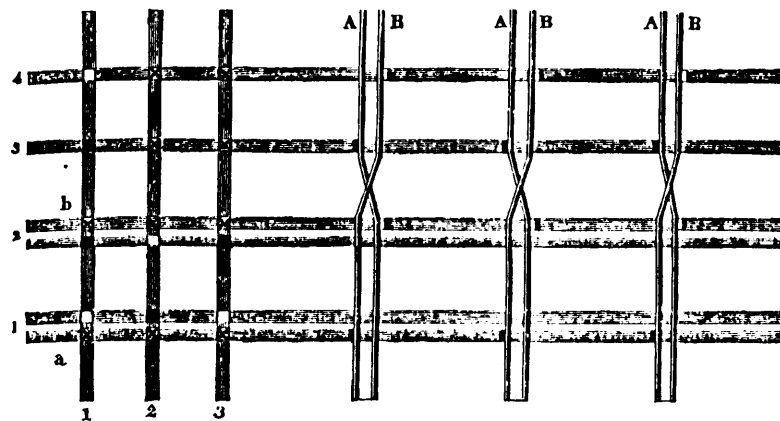
Fig. 52.



It is necessary to observe, that in order to produce the twine or gauze twist, as represented at A* under Fig. 49, in forming the

sheds, the threads do not rise and fall alternately, as in plain weaving, nor at intervals as in tweeling. In both sheds the thread A is always raised and the thread B sunk; but in the open shed, Fig. 49, the threads are not crossed, and in the cross shed, Fig. 50, they are. By examining these two figures (49 and 50,) the way of drawing the warp through the headles will become apparent, and this is an important part of every branch of cross weaving. The thread A is drawn through the third leaf, but as it always rises, it is not taken through the clasp, or eye, of the headle, but above it, through what the weavers usually call the *upper doup*, as at, X² Fig. 49. In like manner the thread B, which always sinks, is drawn through the *under doup* of the fourth leaf as at Y² Figs. 49 and 50. When this has been done, the thread A is crossed under the thread B, as will appear more plainly in Fig. 53,

Fig. 53.



which is a horizontal or ground plan. After being drawn through these two leaves, which are generally called the back mounting, it only remains to cross and draw the warp through the fore mounting. Of the half leaves, one is hung from above, and one rises from below. The one hung from above passes through the lower doup of the leaf or standard 2, and that from below through the upper doup of the standard 1. This will appear very plain in Fig. 51. Through the under half leaf connected with the standard 1, the thread A is drawn, (see Fig. 49) and through the upper half leaf connected with the standard 2, the thread B passes, as in Fig. 49. In Figs. 49 and 50, the shaft of the upper half B², appears as hung between the standards 1 and 2, but this is not the usual practice; for it is found more convenient to place the two standards to-

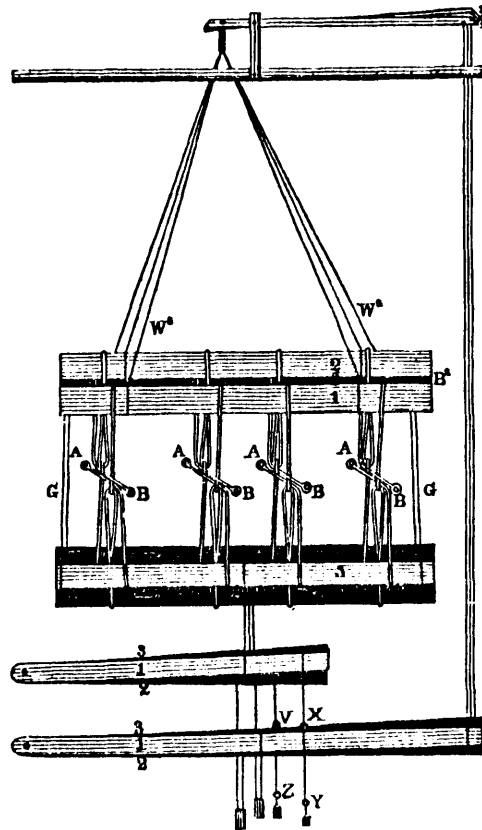
gether, the under half leaf, A², in front of the standard 1, and the upper half, B², behind the standard 2, as in Figs. 51 and 52. By means of the half leaves the alternate crossing of the warp is effected; for in the open shed (Fig. 49,) the half leaves work in an opposite direction to the standards, and leave room for the warp to rise and sink in the space between the standards, while in the cross shed (Fig. 50) the half leaves rise and sink with their respective standards, and force one thread of warp across the other. Thus, when the warp is direct, the half leaves are crossed, and when the mounting is direct, the warp is crossed. This will plainly appear by carefully tracing the threads A and B in Figs. 49 and 50, and also in Figs. 51 and 52, where sections of the threads are represented by round dots, thus (●.) In Fig. 51 the half leaves and standards are crossed as in Fig. 49, and in Fig. 52 the standard 1 is sunk and the standard 2 raised; the mounting will be direct and the warp crossed, as in Fig. 50.

To render the mode of mounting a gauze loom as plain as possible, we shall enter into a more detailed account of the mounting than appears necessary in those kinds of weaving where the horizontal plans of the draught and cording have been long practised and understood by professional men. The novelty of the subject, and *its evident utility*, should we succeed in our explanation, will, we hope, screen us from the charge of unnecessary prolixity.

It has been already stated, that the gauze mounting consists of two back leaves, two standards, and two half leaves. These are moved by two treadles. The intermediate levers are five top levers or couplets, five long, and five short marches. Tracing the headles in regular succession from the front, the first is the under half leaf, A², the second the front standard 1, the third the second standard 2, the fourth the upper half leaf, B², the fifth the first back leaf 3, and the sixth the second back leaf 4 (see Fig. 49.) The two back leaves and the two standards are raised, or sunk, as the case may require, by connecting cords with the marches and treadles, as in other looms. The half leaves have no connection with any treadle, but are lifted, and sunk by the warp, in the open shed Fig. 49; and they are kept tight by weights in the cross shed 50. These weights must, therefore, operate upon the half leaves in the cross shed, and must be relieved in the open.

It will be proper to trace the connections of the leaves with the couplets and marches in the first place, and then to explain the way in which the weights are applied to operate upon the half leaves:

Fig. 54.



1st. The lower half leaf, A, (see Fig. 54,) is attached by a cord *below* to the first short march: it has no connection above. 2d. The first standard is attached by oblique cords W^2 to the first couper *above*; the couper, to the first long march; the standard is connected *below* with the second short march. 3d. The second standard, to the second couper *above*; the couper, to the second long march; the standard, to the third short march *below*. 4th. The upper half leaf, B, to the third couper *above*; the couper, to the third long march: *no connection below*. 5th. The first back leaf 3, to the fourth couper *above*; the couper, to the fourth long march; the leaf 1 to the fourth short march *below*. 6th. The second back leaf, to the fifth couper *above*; the couper, to the fifth long march; the leaf, to the fifth short march *below*.

These connections being formed, it only remains to apply the

weights to their respective marches, and to connect the other marches with the treadles. The mode of applying the weights will appear in Fig. 54. This figure is a transverse section of the *front part* of the mounting of a *whip net*, of which it will be necessary to treat afterwards. In the mean time, as the cording of a common gauze is exactly the same as that of a whip net, it will serve to illustrate that part of the mounting.

The lower leaf, A², (as seen in Fig. 49,) is connected with the first short march. (See Fig. 54.)

The upper half leaf, B, with the third couper above, and from thence with the third long march. (See Fig. 54.)

The application of the weights is therefore as follows :

From the first short march two cords descend, one passing on either side of the first long march, and from these cords the weight is suspended. Above the long march the cords are attached to each end of a piece of wood, Z, (see Fig. 54,) generally a piece sawed or cut from a common spool, by which they are kept asunder to prevent them from rubbing on the long march which works between them. Another piece of the same kind, Y, is fixed below, and from this the other weight is suspended. The same apparatus is applied to the third short march, and passes upon both sides of the third long march, for the upper half leaf.

When the open shed is made, the first standard is pulled down ; this raises the first long march, which consequently lifts the weight, and allows the under half leaf, A², (see Fig. 49,) to rise ; at the same time the second standard is raised ; this, of course, raises the third short march, and relieves the pressure of the weight from the third long march : the upper half leaf, B², is thus allowed to sink. In forming this shed, the standards and half leaves merely yield to the warp, for the raising and sinking are entirely produced by the back leaves (marked 3 and 4, Fig. 49.)

From these explanations, and from a careful examination of the Figs. 49, 50, 51, and 52, the general principle of weaving gauze may be pretty well understood.

The connections with the treadles will be found by examining Fig. 53, which is a horizontal plan, similar to those employed to illustrate other branches of weaving, particularly *damask*, (of which we shall treat in its proper place.) The warp thread A, which is drawn through the upper doup of the first back leaf 3, (see Fig. 53,) is distinguished by a black oblong mark, on the left side of the thread. The thread B, which is drawn through the under doup of the leaf 4, is distinguished by a white oblong mark, on the right

side of the thread. The draught of the warp thread A through the upper half leaf, *b*, is also denoted by a white oblong mark on the right side of the thread; and that through the front half leaf, *a*, by a black oblong mark on the left of the thread B. The connections for raising the back leaves and standards are indicated by black squares; and those for sinking them, by white squares or blanks, all of which will be evident by examining the extreme left of the plan (Fig. 53.) Where no connection from the marches to the treadles is necessary, the mark X is used. As the half leaves are raised and sunk by the warp, no mark is used for the cording of them. The open shed is formed by pressing down the treadle 1, the cross shed by the treadle 2; the treadle 3 merely reverses the motion of the treadle 2, to enable the weaver to work plain cloth as well as gauze, when he finds it convenient. The alternate motion necessary for plain cloth, is entirely performed by the standards and half leaves, the back leaves remaining stationary in this, as well as in the cross shed. But in this shed it is necessary to connect the marches with the plain treadle, to keep the half leaves tight when the weights are raised, the fore mounting in the plain shed being exactly in the same situation as in the open shed.

From the descriptions now given of gauze weaving, we hope that any weaver of even common perception, who will study them with care and attention, will find little difficulty in mounting a gauze loom *for himself*.

When the principle of gauze weaving is thoroughly understood, its application to the weaving of fancy nets may be easily acquired. Many varieties of net work are used, but a few which form the groundwork of all the rest, will be sufficient to elucidate the general principle; and, to use the words of a certain learned doctor of book-making notoriety, "the limits to which it is necessary to restrict this Work, will not admit of more particular details."*

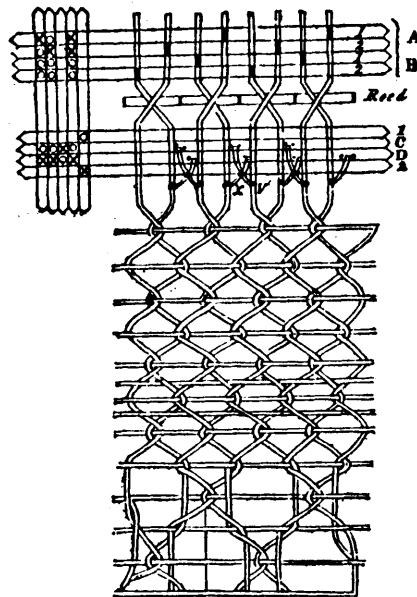
WHIP NET.

This net takes its name from the warp being wholly of whip, without any other ground. The term *whip* is used by weavers to denote a species of warp rolled upon a separate beam to form fancy patterns. In this net the whole warp is of this description; and,

* The principal reason why we are thus restricted is, that we have *already* extracted from the works of others all the valuable or "*luminous*" information which they contained about the manufacture of "*textile fabrics*." See "*Ure's Dictionary*," and "*History of the Cotton manufactures*."

therefore, only one beam or roll is required. The mounting of the whip net, like that of the common gauze, as already described, (see Figs. 49 and 50,) consists of two back leaves, two standards, and two *bead lams* or half leaves. The two back leaves are placed behind the reed in the usual way, and the bread lams with their standards are placed in front of the lay, between the race board and the reed, as formerly mentioned. But as glass beads are frequently used instead of eyes in the back leaves also, and these mountings are generally constructed to weave dropped as well as plain nets, the back headles are usually divided into four leaves; by which the friction is avoided that would be occasioned by the beads being too much crowded together.

Fig. 55.

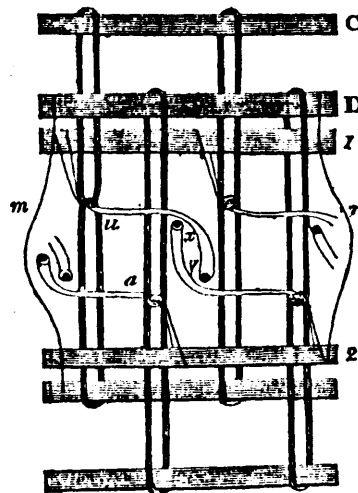


is a plan of the whip net mounting, with a specimen of the cloth annexed, both when it is woven plain, and when it is dropped. A and B are the two back leaves, each of which being divided into the other two parts marked 1 and 2; C and D are the standards; and 1 and 2, the half leaves or bead lams, corresponding with the doups and standards of the full gauze mounting, (see Figs. 49 and 50.) The reed, which shows also the position of the lay, is here seen between the back and front mountings. Let the dots on the leaves C and D represent sections of the twine of which the headles

are made, and they will point out the position of the standards. The upper bead lams with their beads, through which the whip threads are drawn, will then appear as passing through the headles or standards on the leaf C, the beads being in front at *v*; and the under bead lams will be seen as if rising through their standards on the leaf D, crossing below the others towards the front at *x*. The marks on the treadles will point out the raising and sinking cords, as in the plain gauze.

But the manner in which the bead lams cross in front of the standards will appear to more advantage in Fig. 56.

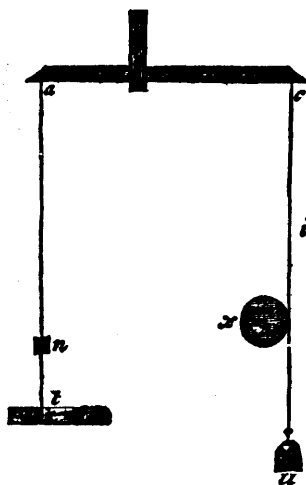
Fig. 56.



Here the upper bead lam shaft is marked 1, and its standard C; the under lam 2, and its standard D, as in Fig. 55. When the open shed is formed, the bead lams assume the position represented in Fig. 56 at *x*, and *v*, that is, the bead lam *x*, on the shaft 2, crosses in front of a standard on the shaft C, and rises on the left of the bead lam *v*, while the bead lam *v*, on the shaft 1, crosses in front of a standard on the shaft D, and sinks on the right of *x*: the threads passing through these two beads, being on the same interval of the reed, this forms the open shed; which is pointed out by the pick 2 in Fig. 55. Again, in forming the cross shed, the bead *v*, is drawn close to its standard at *u*, and the bead *x*, is drawn back to its standard at *a*, (see Fig. 56,) while the standard D is raised, and C sunk, as in the cross shed of the common gauze, (this shed is marked by the pick 1 in Fig. 55,) and thus the crossings of the whip are effected.

It was formerly observed that the back and front mountings of the gauze are placed at about three and a half or four inches apart, that the warp may have sufficient room to twist between them in opening the cross shed. In nets, however, the corresponding crossing of the whip takes place in front of the standards, where it is forced nearly into a vertical position. It is therefore necessary that the whip should be slackened more in the cross shed than any other kind of warp, so as to yield freely to the pressure of the cross treadles; otherwise it would be *almost* impossible to obtain a shed. The method usually employed for this purpose, both for this and the other nets, is as follows: *a o*, Fig. 57,

Fig. 57.



is a couper suspended from the ceiling of the weaving room, or from the top of the loom, from the end *a*, of which a cord descends to the end of a long march *n*, which is again connected to the cross treadle *l*. To the other end *o*, of the lever or couper is tied the cord *i*, which after taking two turns round the whip roll *x*, suspends the pace weight *u*. Sometimes a thong or strap of leather is used for that part which goes round the roll, and a little chalk rubbed upon it to prevent it from slipping. Now, it is plain that when the cross *l*, is pressed down, it sinks the long march *n*, and consequently the end *a*, of the couper, by which the other end *o*, will be raised, and turn the roll round on its axis by the cord *i*. By this means the whip is slackened, and a greater or smaller range is given to it, to suit any given pattern, merely by shifting the fulcrum or centre of motion farther from, or nearer to the end *o*, of the couper.

There is another circumstance which requires particular attention in the manufacture of nets, that does not occur in gauze. In the gauze mounting the two threads of each dent of the reed rise and sink between their respective standards and in the cross shed the doups or half leaves are drawn tight by the weights, so as to pass each other without any friction; especially if the web be properly mounted. In the whip net, however, see Fig. 56, the bead lams project beyond their opposite standards; and, therefore, were the weights allowed to act upon them with their whole force, they would be drawn so tight or close to their standards, as to prevent the beads from *tumbling*, as it is termed; or the cross shed from opening freely. On the other hand, were the bead lams too slack, the friction occasioned by the tumbling of the beads would soon prove destructive to the standards, besides being liable to get frequently entangled among the warp. To prevent both of these inconveniences, each bead lam shaft is connected at each end to the opposite shaft of its respective standard, by a piece of twine called a bridle, as represented at *m, n*, in Fig. 56. By means of these bridles the weaver can temper the front mounting as he pleases, as they are made with snitches, the same as those on the treadle cords of looms for tweeling. Sometimes the under bead lam shaft is bridled to the end of the couper of the front standard, by which method the bridles are kept clear of the shuttle. In general the bead lams project through their standards, when the mounting is stationary, about a quarter of an inch; but every weaver tempers his bridles to such a degree of tension as may best suit the state of his mounting.

It may be further observed of nets in general, that the weaving motions should be *very slow, uniform, and steady*. The sheds are opened by a gradual pressure of the foot upon the treadles, without any sudden jerks, which would cut the whip, and in a short time ruin the mounting. At the same time, the lay is worked with a steady motion, while the shed is opening. The shuttle is driven through the sheds with equal caution, lest it should dip or get entangled among the bead lams or standards. This, however, is in a great measure prevented by pins of brass wire driven into the lay, immediately behind the race board, along which the shuttle runs, instead of the reed as in other kinds of weaving. After the pick has been thrown into the shed, the treadle is relieved in the same gentle way, by which the weights have sufficient time to act upon the bead lams, and keep them in a uniform degree of tension, while the lay is brought forward with the same steady motion to the face of the cloth.

It is also of the greatest importance that all the cordings be properly tempered ; which, with due attention, will be easily effected by means of the snitch knot,* which must be well known to every practical weaver.

As the crossing of the whip in net weaving necessarily produces considerable friction, a greater power is requisite to be exerted on the cross treadle than in any other species of light fabrics : for this reason, the treadles are placed below the warp roll, and the weaver works on the ends towards him, by which he gains the whole of the lever power.

SPIDER AND MAIL NETS.

These two nets are woven in the same mounting, and have the same relation to each other as the gauze and lino.

The mounting is merely that of the common gauze, which is here called the ground, combined with that of the whip net, with which the ground is interwoven.

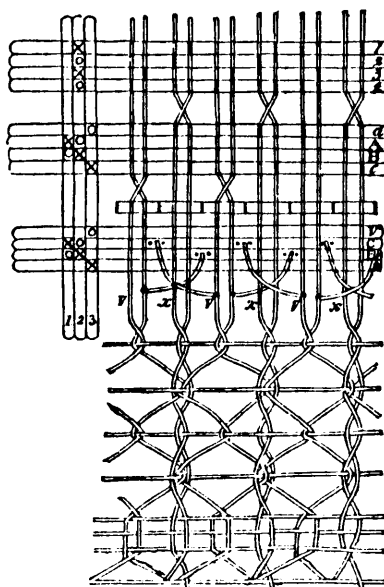
The gauze part of the mounting, and the back leaves of the net, are placed behind the reed ; and the two bead lams and their standards are before it, as in the preceding mounting, (Fig. 55.) Either of the methods for reducing the number of leaves, formerly explained, may be adopted for the ground ; although the full mounting is generally preferred : for, with the full mounting only two warp rolls are necessary, one for the ground and the other for the whip, while either of the former methods require two for the ground, that one-half of the warp may yield a little more than the other while the cross shed is forming.

The Spider net is woven with two treadles which produce the texture of plain gauze, interwoven with the whip : the mail net requires only the addition of a plain treadle on which every fourth pick of weft is thrown, as in Fig. 58.

* This is merely a modification of the *slip knot*, known to Irishmen under the name of *O'Doherty's*, or the *hangman's noose*.

SPIDER NET.

Fig. 58.



is a plan of this mounting, with specimens of the varieties it produces, in which the different crossings of the ground and whip may be easily traced. The back leaves of the gauze are marked 1 and 2, the standards A and B, and the doups, *a* and *c*. The back leaves of the net are marked 3 and 4, and these are all behind the reed as formerly noticed. In the front, between the race board and the reed, are placed the whip standards C and D, with their respective bead lams, *v* and *x*. The position of the whip standards, with respect to the threads of warp, is pointed out by dots on the shafts C and D, one on each side of its respective bead lam; these lams appear in the fig. as if a little slackened by the open shed, and crossing each other in front of the standards, exhibit the whip threads passing through the beads at, *v* and *x*, (see Fig. 58.) The crossing of the bead lams, when the open shed is fully formed, will appear to more advantage in Fig. 56, the threads of gauze warp being in the position of the letters, *v* and *x*.

By comparing this plan with those of the gauze (Figs. 49 and 50) and whip net (Fig. 55) considered separately, the process of taking the warp through the headles and tying up the treadles will be obvious, and can require no further explanation; for each of the

mountings are tied to the treadles in the same order as if they had been mounted separately.

It may be necessary to observe, however, that when the full gauze mounting is employed, as in the present example, or when the back doup and standard are omitted, each treadle will produce similar sheds in both mountings; that is to say, either both open or both cross, but when the gauze part is mounted with the bead lam and standard, it is necessary to cord the treadles so as to produce the open shed of the gauze along with the cross shed of the whip; otherwise the whip would not run in between the threads of gauze warp to form the net distinctly as represented in the specimen. (See Fig. 58.)

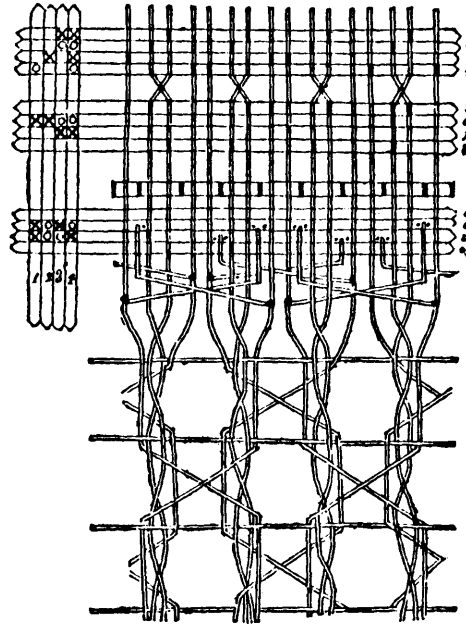
The apparatus for slackening the whip in the cross shed, as well as the bridles for preventing the bead lams from being drawn too close to their standards, are also necessary in this mounting, and are applied in the very same manner as in the whip net.

PATENT NET, OR NIGHT THOUGHT.

This net, like the preceding, consists of a gauze ground interwoven with whip. Two sets of mounting are therefore requisite, one for the ground and the other for the whip or net part; but, as this net involves greater variety than any of those already explained, it requires four treadles to work one set of the pattern. Either the full mounting or one of the contracted methods may be employed for the gauze part, and the whip requires two back leaves, and two bead lams and their standards. When the full gauze mounting is employed three warp rolls are requisite, one for the ground and two for the whip. These last are necessary, as one half of the whip is occasionally crossed while the other half is straight and parallel, and consequently each half must be slackened independently of the other. When the gauze part is woven either with the bead lam shaft, or by omitting the upper doup and standard, two rolls are also necessary for the ground, as formerly described. Some add another roll for the selvages, which, being woven plain without any twist, do not work up equally with the other warp. This, however, is commonly avoided by beaming the selvages on the same roll with the ground, and suspending a small weight to each below the roll to keep them moderately tight, and the slack part is taken in at the face of the cloth, when necessary, at the end of the piece.

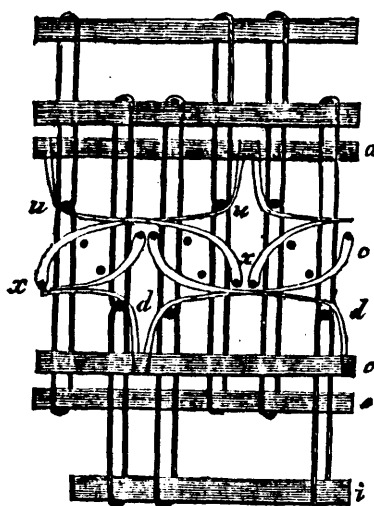
PATENT NET, OR NIGHT THOUGHT.

Fig. 59.



is a plan of the night thought mounting, with a specimen of the cloth, as in the other examples. The shafts marked 1 and 2 are the back leaves for the gauze part, the back leaves for the whip being marked 3 and 4. 5, 6, 7 and 8 are the doups and standards of the ground mounting, which in this example is a full mounting; the bead lams and their standard which are before the threads are marked, *a*, *e*, *i*, *o*, and are placed exactly in the same position as in the other mountings for net weaving.

Fig. 60.



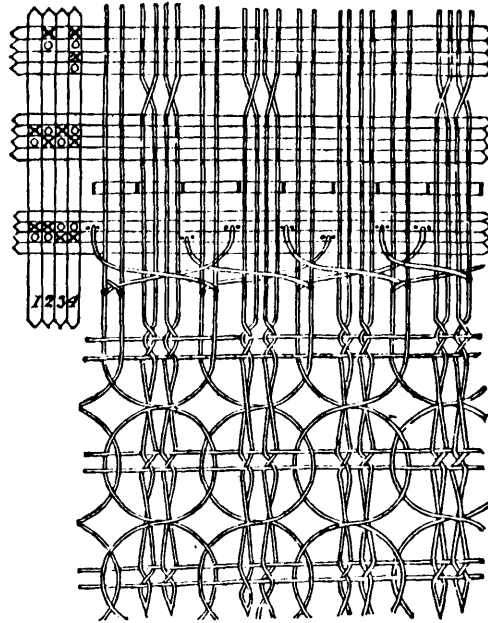
is a front elevation of the beak lams and their standards, representing their position when the open sheds are formed; *a*, is the shaft of the upper beak lams, and *o*, that of the under ones; *e*, and *i*, are the back and fore standards respectively. In the shed here exhibited, which is opened by the treadle marked 4, (see Fig. 59) both the upper and under lams are slack, and after crossing two dents of gauze and one of whip, the former are sunk and the latter raised by the whip which is now acted upon entirely by the back leaves. That is, the upper lams cross from their standards at *u*, to the interval *x*, where they are sunk; and the under ones from *d*, to *c*, where they are raised (see Fig. 60.) The treadle 2 (see Fig. 59) draws both the upper and under lams tight to their standards, by which the former are sunk and the latter raised; at the same time the ground forms the open shed. In the shed formed by treadle 1, the upper lams are tight and sunk by their standards, while the under ones are slack and raised by the whip, the ground forming the cross shed. All this will plainly appear by an attentive perusal of the two Figs. 59 and 60

PRINCESS ROYAL NET.

This net is woven in a mounting the very same as that of Night Thought, but with a small difference in the order of taking the whip through the headles and tying up the treadles.

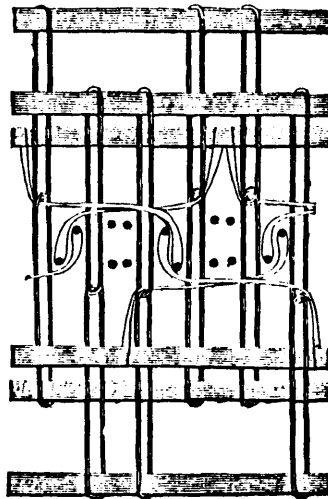
But as these are distinctly marked on the plan Fig. 61.

Fig. 61.



they can require no further explanation. Fig. 62

Fig. 62.



shows the crossing of the bead lams in the open shed in the same manner as in the preceding net.

DROPPED NETS.

The whip and mail nets are frequently ornamented with a variety of figures, which are formed on the cloth merely by preventing the crossings of certain portions of the whip, for one or more picks of weft, which leaves open spaces in the ground larger than the common meshes of the net ; this may be effected either by preventing part of the upper bead lam whip from sinking, or of the under bead lam whip from rising, in the open shed, by means of additional back leaves applied for that purpose.

These examples, it is presumed, will be sufficient to explain the nature and process of net weaving, and to show that by changing the order of the draught, cording and treading, considerable variety may be produced in these fabrics.

SECTION FIFTH.

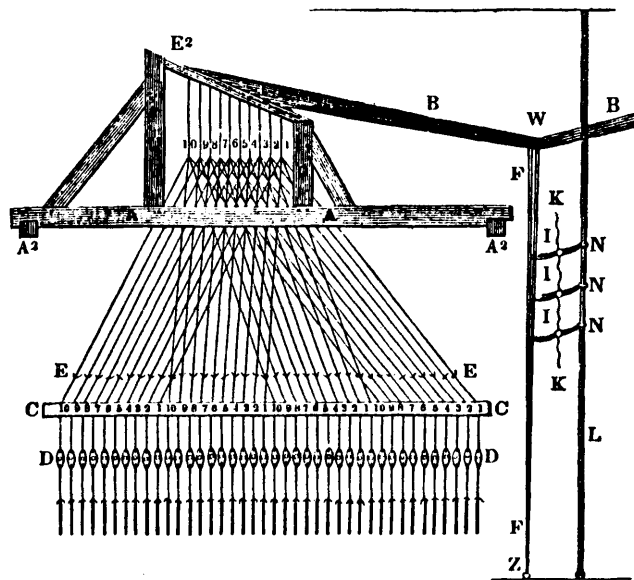
FIGURED WEAVING.

We've heard of labyrinths and gordian knots,
 And other things which try your men of skill ;
 But here we for a time shall turn our thoughts
 To something even more complicated still.

Having described in the preceding sections the elementary principles of weaving, and developed some of their most useful combinations, with the necessary illustrations to make them perfectly understood, it now devolves upon us to show how these principles may be extended beyond the scope of leaves of headles, by aid of the draw loom.

DESCRIPTION OF THE DRAW LOOM.

Fig. 63.

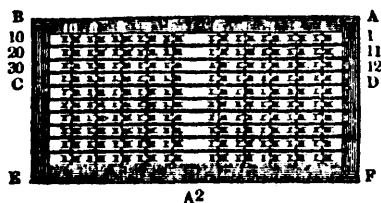


is a front elevation of the common draw loom. The frame AA is called the carriage, from its use in supporting the harness ; and rests on the capes of the loom, which are seen in section at A²A². On the top of this frame is fixed the pulley box E² which contains the

pulleys over which the tail cords run when any part of the harness is raised to form a shed, or sheds.

This box, a horizontal view of which is given in Fig. 64,

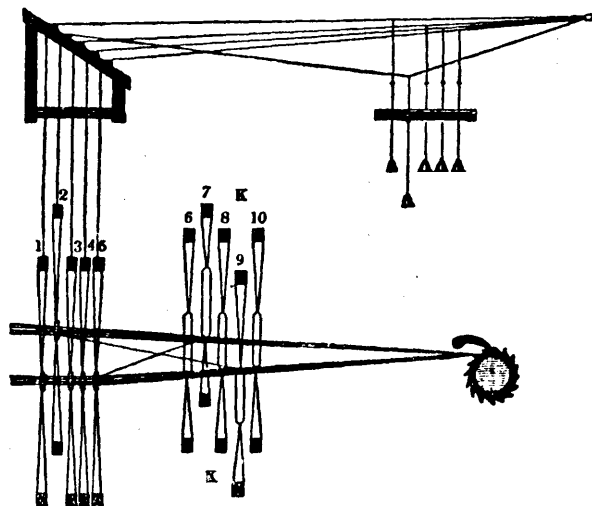
Fig. 64.



is placed in a slanting position sufficient to allow the tail cords BB to sink in opening the sheds, without obstruction from the frame or pulleys below.

The harness is composed of the following parts; namely, the neck twines, which extend from the neck of the harness, as pointed out by the figures of reference 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10, to the knots at EE; the sleepers,* which connect the neck twines with the mails at DD; the mails, which are the substitutes for the eyes of headles, through which the warp threads are drawn, and of which a more distinct view will be found in Fig. 65;

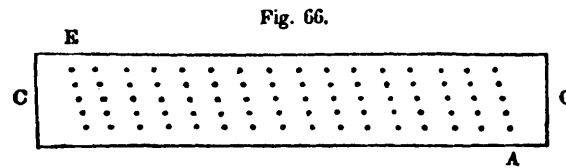
Fig. 65.



* The name usually given to that part of the cords or mountings which passes through the board CC, commencing at the knots EE, and ending at the mails DD.

the twines, that connect the mails and leads or weights at XX, called hangers, to sink the mails after they have been raised to form the shed or sheds.

CC is the hole board,* through which the sleepers pass; and this regulates the distance of the mails and the fineness of the harness. The face of this board is represented in Fig. 66.



in which it will be observed that the holes for the harness twines run in oblique lines, that the mails may have sufficient room to stand directly opposite to their respective intervals of the reed, without being too much crowded together. The reed and harness board, therefore, must be of the same set or fineness; or should a harness board of a finer set than the reed be at any time employed, the supernumerary holes must be left empty at regular intervals and in complete rows, as in the method followed by weavers in setting their headles. It may be observed, however, that although the sets of reeds in America be calculated on 37 inches, yet the sets of the harness board are comprised in 36, so that in 37 inches of the harness board there will be the number of dents contained in one inch of any given set more than in the same breadth of the reed. As each part or division into which the harness is tied begins always with a complete row of the harness board, this addition is made as an allowance for any holes that may be left empty at the ends of such parts as are not multiples of five. Thus were the harness to be tied into such parts as 100, 105, 110, 115, &c., mails, every part would exactly fill a certain number of rows in the harness board when there were five in each row: but in a tie of 102, for instance,

* Called hole board from the fact of its being pierced with a great number of holes; a clearer view of which will be had in Fig. 66. Scotch weavers often call it by the name of "holy brod;" but the words *holy* and *righteous* being almost synonymous, we think the latter of these terms quite as applicable as the former; however, we shall excuse these *broad* Scotchmen, as they are, no doubt, a very *holy* people. Among Yorkshiremen, the appellation of "cumber boord" is used for this part of the loom, from the circumstance of its being much *encumbered* with strings, &c.: but, for our part, we would prefer the Yankee name of "harness board."

there would be three holes left empty at the end of each part ; which, consequently, would make the harness considerably broader than the reed, were it not for the above allowance. It may be further remarked, that, although in the present example there are only five holes in each oblique row in the board, which is the number appropriated to four thread harnesses, yet in dent and full harnesses, where a greater number of mails must necessarily occupy the same space, the number of holes in each row is extended to ten, and in French shawl looms even sometimes to thirty-two.* From these observations it will evidently appear, that two mails will stand opposite to one interval of the reed in a full harness ; one in a split or dent harness ; and in a four thread harness, one mail will occupy the space of two dents or splits of the reed.

From the tail at W descends the simple cords FF, or as they are termed collectively the *simple*, down to the floor at Z, where they are fastened. It is on this part of the draw loom that the pattern is read on from the design paper. The twines at III are termed the *lashes*, and are necessary for separating the simples of any shed which is to be opened from those that remain stationary ; N N N are the heads to which the lashes are attached, and are made to run or slide with a noose on the gut cord L, at pleasure. The gut cord commonly extends from the roof of the shop to the floor, (as shown in Fig. 63,) parallel to the simple. K K are the bridles, which being connected with the lashes at equal distances, draw them down in succession as they are wanted by the draw boy.

The number of mails necessary to produce one set of a pattern, make what is denominated a *part*, or the tie of the harness ; and as every mail in one part must rise independently of the others, each must have its respective cord both in the tail and simple ; so that the greater the range of the pattern, the greater will be the number of simple cords. Hence it is evident, that were a harness to be tied in one part only, there would be a tail and simple cord for each mail in the width of the web. But as patterns of this extent are not very common, it is usual to divide the harness into such a number of parts as may be most suitable to that species of goods on which it is to be employed, and these parts are repeated to make up the full width.

By this means the number of tail and simple cords, together with

* Our friend, Monsieur Dioudonnat, of No. 12 Rue St. Maur, Paris, (France) generally pierces his harness boards with thirty-two holes in the row (in breadth.)