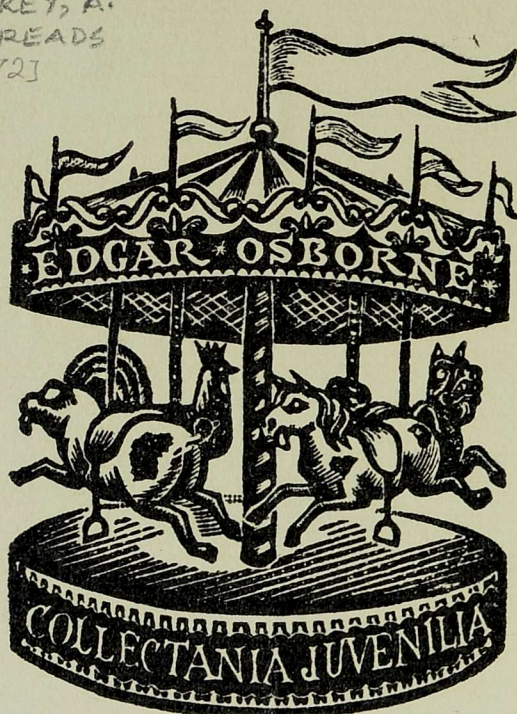




THREADS OF KNOWLEDGE
DRAWN FROM
A CAMBRIC HANDKERCHIEF
A BRUSSELS CARPET A PRINT DRESS

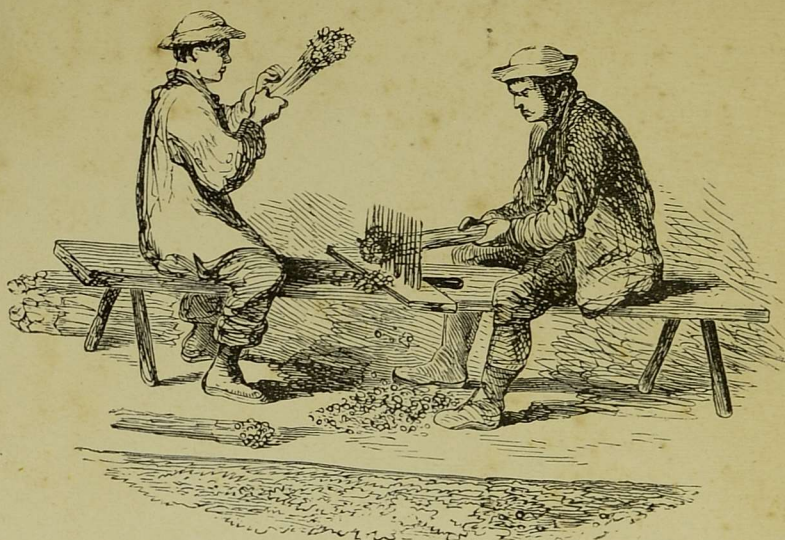
A KID GLOVE
A SHEET OF PAPER
BY
ANNIE CAREY

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CAREY, A.
THREADS
[1872]

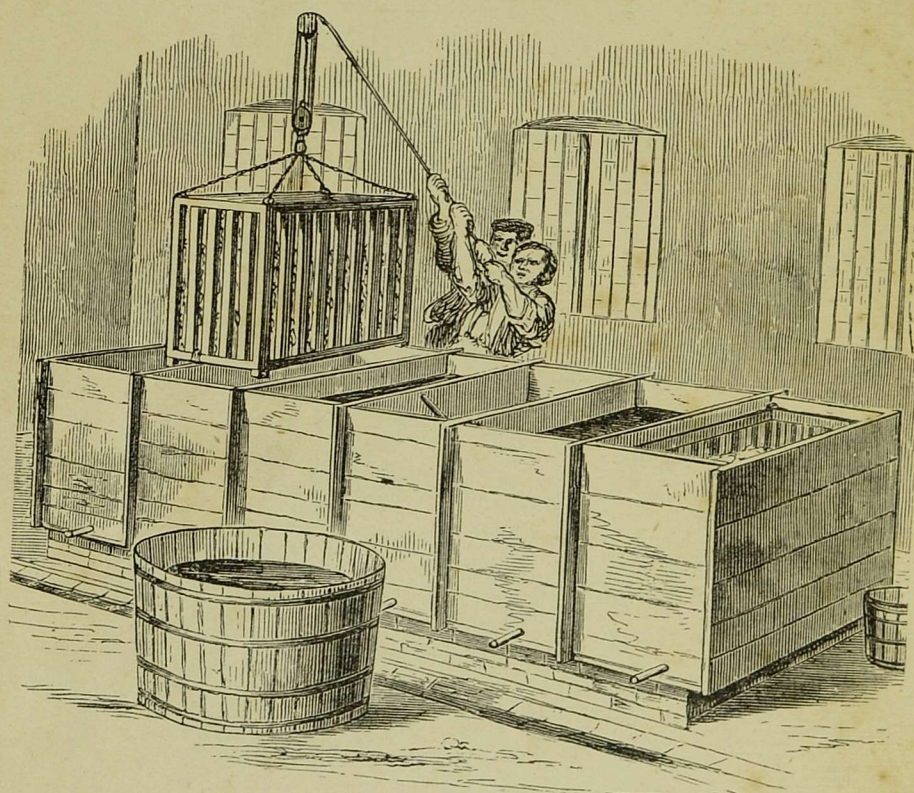


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FLAX PLANT—HAND HECKLING.



STEEPING THE FLAX.

THREADS OF KNOWLEDGE,

DRAWN FROM

A Cambric Handkerchief

A Brussels Carpet;

A Print Dress;

A Kid Glove;

A Sheet of Paper.

BY

ANNIE CAREY,

AUTHOR OF "AUTOBIOGRAPHY OF A LUMP OF COAL," ETC.

CASSELL, PETTER, & GALPIN,

LONDON, PARIS, AND NEW YORK.

P R E F A C E .



THE "Objects" from which these "Threads of Knowledge" have been drawn, may, perhaps, appear to some to be trivial and uninteresting; yet all will allow, that there are no subjects so simple, no objects so commonplace, as not to possess some one or more "Threads," connecting them with others that are at once intricate and wonderful.

But "Threads," be they of what kind they may, are of little value unless *used*; and these "Threads of Knowledge" will be of small worth unless taken up and made the means of acquiring more. Every care has been taken to make the information given, whether relating to the manufacture or the history of the various subjects, as clear and accurate as possible. This by no means implies that every suggestion and

allusion has been explained—every “thread” fully traced out—on the contrary, some have purposely been left for intelligent readers to seek and find for themselves. The “Threads,” it is hoped, may serve to indicate the direction of paths along which parent and child, pupil and teacher, may together travel—paths pleasant in themselves, and leading onwards to fields of knowledge broad and beautiful, and bounded only by the desires and capacities of the travellers.

A. C.

June 1872.

INTRODUCTION.

“It seems to me,” said Mrs. Norton, as her husband laid down the book, from which he had been reading to her, “that the minds of some people are very like this little bag of mine, which contains odds and ends of silk of various kinds and colours, and in which, I have been for some time vainly looking for a piece long enough to mend this hole in your glove. They appear to have a great deal of knowledge, but it is all so jumbled together, and in such short lengths, as to be of little use, either to themselves, or others. They never follow out a thread, and see where it would lead them. Some knot or other hindrance comes in the way, when they immediately break the ‘thread’ in two, and throw the broken bits into their minds. No wonder they never weave anything, either useful or ornamental, into the texture of their lives.”

“A most feminine comparison, Mary,” said Mr. Norton, laughing, “but one that very aptly describes the hero of this book, and of many others besides.

Now I see several pairs of young eyes eager to ask you, what you can possibly mean by this remark of yours. I know it is the weird hour when these youngsters claim you for their special property and private purposes; and as the comparison is *yours*, and not mine, I shall go and see some patients, and leave you to run the gauntlet alone—*au revoir*."

"Yes, mamma," said Maggie, a child of about ten; "it is as papa says—you are *ours*, you know, for the next hour. So will you please explain what you mean about these '*threads*' and people's minds."

"Yes, please, do, for I know, mamma, by your face and voice that you were *feeling* your own thought," said Sydney, a thoughtful, sensitive boy, between fourteen and fifteen years of age, who had a remarkably quick perception of his mother's thoughts and feelings.

"Well, it is difficult to explain and justify a comparison," replied Mrs. Norton, "it is apt to fall to pieces in the attempt. Besides, I think you can all make out for yourselves, what I meant to convey."

"I think *I* can, mamma," said Carrie, aged thirteen, "and so can Syd I have no doubt; but, still, we should like you to talk to us a little about it."

"You all know," said Mrs. Norton, "that the knowledge you are getting day by day, upon various subjects, can only be the elements, or beginnings of them. Parents and teachers can only give their pupils the *ends of threads*, so to speak; threads, that if you are

patient and inquiring, will unwind and unwind themselves from the endless web of knowledge, and will lead you into many pleasant paths; but, if you are careless and impatient, and loose hold of the ends, or break them off short, you will never be much the better for your knowledge. Your minds will be only a collection of little bits of thread. Do you see what I mean?"

"Yes. But what did you mean by not 'weaving knowledge into their lives?' How can any one do *that*, mamma?"

"I cannot explain that to you, fully, Carrie, you will understand it better, when you are older; meanwhile, be very sure of this, that all the knowledge which we put into our minds, ought, sooner or later to have an influence for good upon our everyday life."

"But, mamma," exclaimed Arthur, a boy of twelve, "of what possible use can my Latin verses be, to me, or to any one else? If they are '*threads*,' they are precious ugly ones, and with plenty of hard knots in them."

"And dates and tables and grammar, they are not at all pretty threads; and then I have only got such little bits of them, that I am sure, mamma, they cannot be of any use," said Maggie.

"Short lengths are certainly not of very much use to the weaver," replied Mrs. Norton, smiling; "but, Maggie, there are such things as 'weaver's knots,'

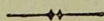
proper ways of tying one piece of thread on to another ; therefore I advise you and Arthur not to throw your ends away in a hurry, you may find them of use.

"Now, I have a proposal to make to you ; which is, that during this twilight hour which we spend together, we should try and draw out some of the threads of knowledge that may be found in some one particular object that we see and use every day. I suspect that as we proceed in our work, you will each of you find that many of the 'threads' you already possess, even the short lengths, those of which Maggie and Arthur speak so slightly, will find a place, and will get woven in with the rest."

"Capital, capital !" exclaimed all ; "when shall we begin ?"

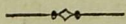
"To-morrow night," replied Mrs. Norton, "I will try and unravel for you some of the Threads of Knowledge to be found in—— But no, I will not tell you till we meet."

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THREADS OF KNOWLEDGE.



A CAMBRIC HANDKERCHIEF.

“AMMA, Arthur and I hope that some of your ‘threads’ may lead us into an enchanted wood, or into some bower where we might find a captive Princess, or perhaps another Fair Rosamond,” said Maggie, at their next meeting.

“That would exactly suit our Pendragon, because he could act the knight and deliver her,

“Oh, rather he chose, that Monarch bold,
On venturous quest to ride,
In plate and mail, by wood and wold,
Than, in ermine trapped and cloth of gold,
In princely bower to bide.’

That’s *you*, all over, is it not, Pen?” said Sydney, laughing.

Arthur was as often called by the name of “Pen,”

or "Pendragon," as by his own. His admiration of his great hero was unbounded, but it must be confessed he was a somewhat clumsy version of the Tennysonian King Arthur. Brave and reckless, with all a healthy boy's desire for adventure, with a crude yet strong love of justice and truth, he was ever ready in his own fashion to "ride abroad redressing human wrongs," or as Syd paraphrased it, "To ride abroad upsetting rights and wrongs."

Between him and his elder brother there were often small wordy combats, though at the bottom of their hearts each held the other in highest esteem. Arthur described Sydney as "an awful clever fellow at books, and with lots of pluck in him too, though he does like Tennyson and such things just like a girl," and Sydney admired almost to envy his brother's courage, strength, and daring exploits, in which his own delicate health forbade his sharing.

"I cannot promise either you or Arthur, Maggie," replied Mrs. Norton, "that my 'threads' shall lead you into any glorious or perilous adventures. They may perhaps conduct you into some difficulties, but if they do, I hope by following them you will find your way out again. To-night I propose that we try and weave a web from the threads connected with *this Cambric Handkerchief*."

"Of what is it made, Carrie, do you say?"

"It is made of *linen*, is it not," replied Carrie; "but I do not know why we call it 'Cambric.'"

"Yes; Cambric is only a name for *fine* linen, called

so, I believe from Cambray, the place where it was first manufactured."

"What does linen come from, Arthur?"

"I never thought about it, mamma," replied Arthur, "but I suppose from the linen plant, like cotton from the cotton plant, and silk—"

"From the silk *plant*, were you going to observe?" said Syd, with much politeness.

Mrs. Norton adroitly turned the tables on Mr. Syd by requesting him to favour them with the German or English name of the plant from which the Cambric Handkerchief had been made. Sydney's answer not being so ready as might have been expected, Mrs. Norton resumed :

"We call the plant by one name, the material produced from it by another ; the plant in English is called Flax : in German *Flachs*, and other Northern nations give it similar names. In Latin, as you know, the plant is called *Linum*, and in all southern European nations, whose language is derived from Latin, the name is analogous.

"This Handkerchief is made from the fibres of the *Flax* plant—the *Linum usitatissimum*."

"What is the plant like, mamma, and does it grow in England?" asked Carrie.

"It is cultivated to some extent in a few counties, and it seems to be a great pity that it is not more so, for it is well suited to our climate, and thrives on almost any soil. It is an annual plant, and has a slender upright stalk, and narrow alternate leaves. When it is

about two-and-a-half or three feet high, the stalk divides into slender foot-stalks which bear a delicate indented blue flower. The seed is sown in March and blooms in July, and then a Flax field is a very pretty object. The flower produces a large globular seed vessel, with many cells in it, and in each cell there is a bright long seed: this seed yields the famous linseed oil, and among the Hindoos the plant is cultivated *only* for its seed. Not so with other people, for the stalk is the most valuable. This stem is hollow, and surrounded with a fibrous rind, and it is from these threads or fibres, when properly prepared, that we manufacture the material we call Linen."

"This soft handkerchief of papa's does not feel very much as if it could be made from the *stalk* of a plant," said Maggie.

"I dare say not, Maggie, but please to unravel this piece of an old one, and not that," replied her mother, putting a piece of old Cambric into her hand. "You will see that the stem requires a very great deal to be done to it, before it can be woven. It must first be carefully *pulled* and laid in handfuls across each other, and then the seeds and leaves are taken away from the stems. After that the bundles of flax must be well steeped. The stalk consists of a woody part and of a fibrous part, united by a kind of resin. The object of *steeping* is to dissolve the resin and separate the fibres from the wood. In order to do this, the old plan used to be to place the bundles of flax, the seed end of one against the root end of

the other, in running water or pools, called 'steep pools.' This took a long time, sometimes even three weeks. The resin is difficult to dissolve, and if left in it is very prejudicial to the fibres. Another plan which answers better is to place the bundles of flax in wooden or stone tanks partly filled with water, and to cause both hot and cold water to flow into the tanks through pipes. In about fifty-four hours the resin is dissolved, the filaments are soft to the touch, and easily separated from the woody part. A French gentleman, M. Claussen, advises that the flax should be boiled in caustic soda, or lime for six or seven hours, when the flax assumes the appearance and state of downy cotton. After the steeping, the flax has to be carefully dried."

"Is it ready now for the weaving?" asked Sydney.

"Indeed, no. It has to undergo a great deal more. It must be crushed, or 'scutched,' as it is called, and then 'beaten.' These operations are still in some countries performed by hand, in others by machinery, and the result is, to *break up* the woody part of the stalk and to *beat* away the bits from the fibres. The flax is then divided into three parts, each about ten or twelve inches long; and now you may take it to the flax mill to be *heckled*."

"What a strange word, mamma; I cannot help wishing there were not so many hard words. Is it *much* use to tell us these names?" asked Maggie.

"I am sorry my 'threads' have such tiresome knots

in them, Maggie ; but if I did not tell you these words and explain their meaning to you, you would be puzzled and perhaps altogether stopped when you meet with them in books which I hope you will some day read ; for you know I want my 'threads' to lead you to sources of more knowledge. Do you see my reason now ?"

"Yes, quite well, and thank you, mamma ; I will not mind the knots," replied Maggie.

"Especially as mamma unties all the hard ones for us," said Carrie. "Now please tell us, mamma, what 'heckling' means, and what it does to the flax."

"To *heckle* the flax, is really to *comb it out*, and by this combing, to cleanse, straighten, separate, and perhaps split the fibres. A *hand* heckle is a square frame of wood with rows of iron teeth upon it about four inches long. A man takes up a handful of flax in the middle and draws it through and through the teeth of the comb, first one end and then the other. But I wish I could take you into the large heckling room of one of our great flax mills, and show you the number of machines, each with its roller or cylinder armed with a number of sharp, strong heckling teeth, and the children busily at work giving the flax to the sharp teeth to work upon."

"Never mind, mamma, tell us all you can, that will be the next best thing," said Syd.

"You would see that some of the children take up the handfuls of flax, and fix one end of each handful

firmly into an iron clasp ; others take the clasped bundles and hang them up in front of the great cylinder of the first machine ; the cylinder rolls round, and its teeth pass down and through the hanging flax. The bundles are hung up in front of several machines in succession, each cylinder having finer teeth than the last one. When the flax is taken down from the last it is a soft, fine, glistening fibre of a silver grey or yellowish-white colour. All the dirt and all the short fibres have been taken away from it by the heckling. The short fibres are called *tow*, and can be used for inferior kinds of yarn or thread."

"How pretty it will look ; and is it ready now to make linen of?" asked Maggie.

"Not quite ; it is merely in the state of a fine unconnected fibre about ten or twelve inches long. These distinct fibres will have to be formed into a long continuous 'band.' The bundles of heckled flax will be spread out, so that the ends of one come to the middle of the other, and then the flax will be drawn through heckle teeth and made to pass between different pairs of rollers. This combing out and *drawing through* between rollers is repeated several times, and each time the band is doubled and redoubled, till the *drawn* flax is a perfectly smooth, flat, glossy *band*, of equal width and thickness in every part. This 'drawing,' or long band, is then taken to other machines, which *draw* it out still more and more, till it forms a soft small round cord, or 'roving.' This 'roving' is now wound upon bobbins or reels, and is

ready to be spun into *thread* for the weaver. Flax requires to be spun while *wet*, and does better with *hot* water than with cold."

"Why will it not do just as it is, mamma? is it not fine enough even yet?" said Carrie.

"It is not fine enough, and it is not *strong* enough."

"But how can *spinning* it make it stronger? I should have thought it would do the opposite to it," said Sydney.

"How would you define 'spinning,' Syd?" said his mother.

"I hardly know what to say," replied Syd, "but I looked in Johnson this morning, and saw that he gives, 'to spin: to draw out into threads.'"

"True. Spinning is certainly the drawing out and lengthening of thread, but it is something more—it is giving the thread a *twist round itself* while it is being drawn out, and it is this *twist* which makes the fibre into compact thread."

"Of course the *twist* would strengthen the thread. I can see that. Can you tell us how it is done, mamma?" said Sydney.

"I am almost afraid not—the modern machinery is so complicated. Perhaps I can give you some little idea of the plan by which in various ways and with all kinds of appliances the object is accomplished. You understand that the design of spinning is to unite short lengths of thread so as to make them into one thread; to draw out the thread so as to make it of the needful fineness, and at the same time to twist the

fibres of the thread so as to make it compact and firm ; so far, so good. Now, suppose you take a number of bobbins or reels on which the threads or fibres have been wound (the size and number of bobbins does not matter), run a rod or spindle through them on which they can turn, and hang them up in a frame *horizontally*; then take a number of *empty bobbins* and place them underneath in an *upright* position. Put a spindle through each upright reel, so that it can turn round. At the top of each upright spindle you must have a piece of metal or wood, shaped something like the prongs of a fork, which must also be able to turn round. Now unwind the thread from your horizontal bobbins, bring the end from each down upon the 'fork' belonging to each *upright* bobbin. Unwind slowly, but make the 'fork' and the upright bobbins go round very quickly. What do you suppose would be the result of the thread being made to *turn round* quickly while it was being wound off slowly?"

"Why it must be twisted round and round itself," exclaimed Carrie.

"Just so, and a machine constructed to carry out this plan is called 'the bobbin and fly machine.'"

"Because of that fork thing flying round so, I suppose," said Carrie.

"Possibly—these 'fliers' as they are called, go round so quickly that they produce a kind of humming noise which has procured for some variety of this kind of machine the name of 'the throstle machine,' though I think our dear throstle, or thrush would be unable to

recognise any of his own notes. Some machines are very complicated ;—they unwind the thread—stretch it out, some by passing the rovings as they leave the bobbins, between rollers ; others by drawing the vertical spindles out on a kind of carriage, for four or five feet—twist it, and wind it afresh with the most wonderful quickness and precision. Now Carrie, can you wind up our threads and tell us how many things have been done to our flax before it can be rightly called ‘thread’ ? ”

“ Let me see,” said Carrie ; “ the flax was pulled, then steeped, dried, beaten, crushed, heckled, drawn out several times over till——”

“ It became a smooth flat ‘band,’ and then after that a ‘roving’ or small round cord,” put in Syd.

“ And then it was spun—lengthened out and twisted, and so made into thread, and wound and made up in ‘hanks’ or skeins,” continued Carrie.

“ Very good,” said Mrs. Norton. “ Now are you tired of the ‘threads,’ or shall we ‘mount our loom’ and weave our Cambric cloth ? ”

“ Oh, go on please, mamma,” replied all the children.

“ Very well. How would you explain the meaning of the term *weaving* ? ” resumed Mrs. Norton.

“ Oh, Carrie ought to be able to answer that the best ; spinning and weaving have never been *men’s* work,” exclaimed Arthur.

“ Don’t be too sure of that, Mr. Arthur, you may find yourself mistaken when we unwind some of the history threads. But defining a term is certainly within

the compass of men's business, judging from the number of dictionaries that are given to us."

No one seemed ready with an answer, so Mrs. Norton went on :

"To weave is to unite threads, or strips of material, by interlacing one with the other ; plaiting, darning, netting are all forms of weaving.

"We left our flax thread wound upon bobbins, did we not? Well, before we can weave, it must be unwound and prepared for the loom by being 'warped'—that is arranged carefully in parallel lines. This used to be done in the open air in a simple manner, by a person walking backwards and forwards between two sets of posts and hooks, and passing the threads over them. There is a poem by Dyer in which it is said or sung that the warper

'Strains the warp
Along the garden walk, or highway side
Smoothing the threads.'

"I need hardly tell you, that now, it is done by a machine. When the thread is thus warped, it must be wound very evenly on a *beam* or roller, ready for the loom.

"Now before we 'mount our loom,' I want you clearly to understand that in every piece of woven materials there are two distinct sets of threads. The threads that run the *length* of the web are called *the warp*, and those that run across, on the width way, are called the *weft* or the *woof*.

"I think I had better explain to you the chief

points belonging to *plain* weaving and to the *hand* loom, because you will then be more able to understand what you see and the reason for the different parts of more complicated machinery, should you ever have the opportunity of going over a cotton or flax mill.

“If you think of a four-post bedstead without curtains or sacking, you will have the framework of a hand loom. At one end, there is the roller, on which the *warp* threads have been wound. At the other end a roller on which the cloth is to be wound—when woven. Now you will need a pair of ‘healds’ or heddles.”

“Oh, dear me, mamma, what can those be?” said Maggie, in alarm.

“They are simply two wooden frames with a number of upright strings fastened to them (something like my canvas frame, perhaps, with the threads only one way); in the middle of every string there is a loop or eye. There must be as many threads in the two healds together, as there are warp threads to be stretched out on your loom. Half of the warp threads, that is *every alternate* thread, will have to be passed through the eyes in the strings of one of the healds, and the other half of the warp threads through the loops of the other heald. Underneath your stretched warp threads you must have two treadles; from each of these treadles a string will pass and be joined to one or other of these healds.

“Now I think we are ready to begin to weave—*i.e.*,

if the warp threads are stretched and passed through the healds."

"All right mamma, we are quite ready to weave our cloth," cried Arthur; "what is the first thing to do?"

"There are three things you will have to do. Seated in front of your loom, you must first put the right treadle down with your right foot, by which you will lower the right heald, or set of strings, which is connected with it, and of course as the heald goes down, so will all those warp strings that have been passed through it. By thus lowering one set of threads you will have made a passage, called in weaver's language a '*shed*.' Through this passage your next action will be to throw your shuttle."

"What is the shuttle like, mamma?" asked Maggie.

"It is a piece of wood, shaped something like a boat, and hollowed out in the middle, on which the yarn, that is the weft thread, has to be wound. The shuttle flies through the '*shed*' and leaves the weft thread across the warp threads, under those that have been lifted up, and over those that are not lifted up.

"Now the third thing the weaver has to do, is to make the weft thread lie close and straight. To do this he uses a thing called a '*batten*,' or beater. It is a frame with a kind of comb at the lower end, through the teeth of which the warp threads pass. The weaver can make this '*batten*' swing against the thread with just as much force as he likes, and the thread is beaten up close and straight.

"Thus one cross or weft thread is laid. The next must be done in exactly the same way, only that the weaver must use the other hand and foot. He must lower the left treadle with the left foot, which will lower the other heald and the other set of warp threads, and along the path thus made, he must cast the shuttle from *left* to right, instead from *right* to left as before, drive the weft thread close up to the other one, and then go on over and over again till he has finished his web."

"Well, mamma, that seems simple enough; I believe *we* could make a loom with that old crib of Maggie's," said Arthur.

"You would find more difficulties than you fancy, Arthur, because you would need certain contrivances by which to turn your rollers, and pulleys over which the strings must pass which connect the healds with the treadles.

"But I think you can all understand and remember the main parts of the machinery employed—the names given to those parts, and the principal things that have to be done in weaving a simple web of cloth."

"Of course," continued Mrs. Norton, "as there are so very many varieties of woven textures, there are many corresponding differences in the nature of the yarn, and in the arrangements of the loom. In our Cambric Handkerchief the warp and weft threads cross alternately, and are of equal fineness, but in some fibres the *weft* thread will pass under *one* and *over* three, four, or even as many as fifteen of the warp threads. The warp may be of one kind of yarn, the

weft of another ; one may be of wool and the other of silk, or of cotton, or flax : or the warp may be of one colour, the weft of another, which produces that peculiar effect seen on what is called 'shot' silk.

"Now I should like to give you a little of the *history* of the arts of spinning and weaving, but I feel afraid lest I should lead you and myself into a worse labyrinth than that of ancient Crete, in which Theseus lost his way."

"And we cannot do for you what Ariadne did for him, *we* have no thread to give you, mamma," said Syd. "I hope and suspect you have one hidden in your own hand."

"If I had been that Theseus," exclaimed Arthur, "I would have cut my way out with my good sword, and not have depended upon a *thread*; besides, I am sure I should have lost or broken it."

"Then, my good fellow, if you had been that Theseus, you would have remained in that labyrinth until this very day," replied Sydney.

"My trouble is," resumed Mrs. Norton, "not that I have *no* thread, but that I have so many in my hand. There are the threads connected with the history of linen, cotton, wool, silk, lace, and stocking weaving."

"Well, mamma," said Carrie, "you must 'warp' your threads, arrange them in straight, parallel lines—"

"Or else *spin* them into one long continuous thread," said Maggie.

"Very good suggestions, both of them," rejoined Mrs. Norton, laughing. "I must see if I can adopt

them. It will certainly not be wise to unwind all the threads at once to their full length. I will therefore begin with those that belong to our own age and our own country, and then go gradually further and further back to other lands and past times.

“In Great Britain, during the last twenty years, many great improvements have been made in the methods and the machinery belonging to the manufacture of woven materials. Steam power, is now largely used in most, if not all the different branches of wool, cotton, silk, linen, and lace manufactures.

“If I were to take you into one of the large rooms or ‘sheds’ of one of our chief factories, you would see from one to two thousand power looms (that means, looms worked by steam) arranged in rows, each loom about three or four feet high and five or six wide ; and as all are worked by steam, I leave you to imagine the noise. The steam power can do all those things I mentioned to you when we were talking about the hand loom—it can wind the yarn on the beam, raise and depress the healds, cast the shuttle, strike the batten, wind the woven cloth upon the roller ; and in some power looms there is an arrangement by means of which the machine is instantly stopped, by itself as it were, if the shuttle becomes entangled—a thread breaks, or any small accident occurs. One woman and a girl can with ease guide and attend to four looms. In other parts of the factory, you may see all the different processes of preparing the fibre and spinning it into yarn ready for the weaver. Many

of these will be carried on by steam power, especially the spinning by the 'self-acting mule,' or 'iron man' as it is called in some parts of Lancashire,—that machine in which the spindles are placed on movable carriages which can be drawn out some four or five feet, and by which the 'roving' is stretched, while at the same time it is twisted."

"Why, Steam is a capital fellow," exclaimed Arthur. "He seems to do everybody's work, a regular servant-of-all-work."

"Yes; but there is an agent more wonderful than steam, that does our bidding more swiftly, surely, and I had almost said, *intelligently*. It is far more serviceable than the 'tricksy spirits of the air' or genii of the lamp have ever been, even when in their most obliging moods."

"Ah, you mean electricity, I expect," said Sydney; "but what can that do in a factory, of all places?"

"It is made the moving power in a most delicate piece of machinery, attached to looms for carpet, and silk, and lace weaving, and of which I will try to give you some little idea another time.

"The progress made by Great Britain since the Exhibition of 1851, both as to taste in design and excellence of material, is very great; and, judging from the Jurors' report of the Exhibition of 1862, she may challenge comparison with any nation. Indeed, in some departments, she carries away the palm. Her spinners of *fine* flax yarn stand the first, and her manufacture of woollen broad cloth and her productions

of cheap and serviceable cotton goods are not to be surpassed by any nation."

"I am glad to hear *that*, mamma," said Carrie. "It always provokes me to hear foreign things, especially *French* ones, made so much of. I think our own are every bit as good!"

"Let us be just as well as patriotic, if you please, Carrie," rejoined her mother, laughing. "There is no question but that at the Exhibition of 1851, France clearly showed a very great superiority over us, as to skill and taste, in most departments of textile fabrics. Still, for your comfort, I will confess that the preference shown to French over English designs is often due to the caprices of fashion and the prejudices of ignorance. It was whispered into your Aunt Bertha's ear, when she was a student in the School of Art, to the effect that a certain design which was being extolled as '*manifestly from the French school*,' was recognised by one who had every reason to know that it had been produced by brains and hands that were simply and entirely *English*. It had been sent over to France and brought back again, that its value might be enhanced in the eyes of the British public."

"What a shame," said Arthur; "but we shall beat them some day, I know."

"Who first thought of working looms by steam power?" asked Sydney.

"That would be a difficult, if not an impossible question to answer correctly, Syd. A Dr. Cartwright claims to be mentioned as one of the first who suc-

ceeded in getting the idea carried out, and in 1787 there were four hundred of his looms at work in a mill at Manchester. But the mill was burnt and the property destroyed by the enraged hand weavers. Some day you must read for yourselves the history of the rise and progress of the arts of spinning and weaving during the last century. You will find it a history of much misery and many mistakes; of outbreaks of passion and prejudice, and of displays of patience, energy and perseverance—of genius and of heroism. At present I can only give you the merest outline of it.

“At the beginning of the eighteenth century, spinning and weaving in this country were entirely done by *hand*, with very simple machinery, and generally at the cottagers’ homes. The man would go and buy his wool or cotton from the nearest market, and bring it home for his wife and children to spin and weave up into materials either for their own use or for sale.”

“Well, mamma,” said Maggie, “I think *that* is a much nicer way than doing it in your noisy factories.”

“I confess it has a pleasant sound, Maggie, and one likes to think of Cowper’s

——‘Cottager who sits at her own door,
Pillow and bobbin all her little store,’

or to fancy one hears the whirr of the spinning-wheel plied by the good wife in the corner of the large old kitchen in the ‘good old times.’

“But men’s brains must work and seek for better ways of doing old things, as well as find out new things to be done; else the world would stand still, or

run 'spinning down the groves of change' the backward way.

"Besides, you must remember that the introduction of machinery and the 'factory system' has been the means not only of increasing the amount of work done (one spinner being able to do in a day now, what would have taken a year to accomplish under the old method), but also of providing employment for vast numbers of people. Just to give you an instance: in the county of Yorkshire there are about 924 factories, 11,406 power looms, and upwards of 50,000 people employed.

"And there is still some work left that women can do at their own homes. The making of Pillow Lace in the counties of Buckinghamshire, Oxfordshire, and Bedfordshire, gives occupation to about 25,000 women. At Alençon, in France, about 8,000 women are occupied in working 'real' lace. Making black lace shawls at Caen and Bayeux, a few years ago, gave employment to as many as 50,000 women. The lace workers of these towns have a great reputation for cleverness."

"Mamma," said Carrie, "I am always puzzled to know how people, ladies I mean, can tell so immediately the difference between 'real' lace, and lace that's not 'real': grandmamma seems to know directly she touches a piece."

"I have no great skill in discerning the difference, Carrie, I am a little ashamed to say, but in 'real' lace both the meshes—*i.e.*, the ground and the pattern—are worked by *hand*; while in 'machine' lace

the ground is *woven*. Then I have read that in 'real lace, mesh and pattern are both made of *flax* thread, and in 'machine' made, cotton thread is generally used for the ground.

"Alençon lace is all done by the needle, so you see, Maggie, the machines do not have all the work in their own grasp—but let us return to them.

"The old spinning-wheel could only spin *one* thread at a time, and a clever working man, James Hargreaves, invented a machine that could spin *several* threads at once. He succeeded so well that his wife and daughters were able to spin a much greater quantity of yarn than their neighbours. The neighbours, therefore, I am ashamed to say, broke the machine to pieces, and Hargreaves left the place and took his invention to Nottingham. It very soon became generally used, and went by the name of 'The *Spinning-Jenny*.' It was invented in the year 1764."

"What a strange name," said Maggie ; "did he call it so after his wife, or one of his daughters?"

"Perhaps, at least that is one of the reasons suggested for the name. But I have read that 'Jenny' was originally 'Ginny' and that 'gin' is the Lancashire abbreviation of *engine*, and that Mrs. Hargreaves one day said to her daughter Mary 'Thou *gins* away famously.' The writer from whom I gathered this, says, that he had the information from a grandson of Hargreaves, so one would suppose it is the correct version of the name."

"This was the first great improvement, and others

quickly followed. A young lad named Richard Arkwright, apprentice to a barber, at Bolton, a lad of great native genius and of dauntless energy, resolved that he would make a machine which should produce a good firm cotton yarn fit for the warp thread, instead of having to use a *linen* one, as the weavers were obliged to do. He rose at five and worked till nine at night, and after difficulties and discouragements, too many to be told, he succeeded in producing, in 1769, a most clever machine. It, in fact, embodied the principle of the Bobbin and Fly machine. The wheel was turned in this machine by water, and the yarn produced by it was called the 'water twist.'

"Richard Arkwright was indeed a genius, he studied the whole subject of the manufacture of cotton in a way it had never been before; and established, it is said, the first cotton mill in Manchester, now so world-wide famous for them. Sir Richard also may be said to have been the introducer of our 'factory system' so prevalent in our day. His machines required more space than a cottage could supply, and more money to work them with than a poor man's purse could afford."

"*Sir* Richard! then the barber's apprentice got on in the world," remarked Sydney.

"Yes, I am glad to say he was universally respected and looked up to, and gained both money and rank. George III. knighted him.

"One thing I must tell you about Sir Richard. After he was fifty years of age, he used to take away two hours from his sleep, in order that he might weave into

his own life such 'ugly threads' as English grammar and spelling ; threads which had been left out when he was young."

"Well, that was showing a real love for knowledge," said Carrie, "because as he had lived so long without such 'threads,' he might have thought he could do very well as he was, till he died."

"Arkwright was succeeded in the search after improvements by Samuel Crompton, a man of great energy and power. Working in secrecy and patience in the garret of his house, at Bolton, he invented the machine that goes in the weaver's language by the name of the 'mule jenny,' the movable carriage on which the spindles of which I have told you are placed. At first, that is about the year 1770, the carriage had only twenty or thirty spindles mounted on it. Since then, it has been made to carry from one thousand to two thousand, and complicated as are the movements, one spinner can attend to all. With all his care, Crompton could not defend himself from the cruel curiosity of his neighbours. They actually climbed the wall of his house, peered into his lonely garret and stole his secret."

"The sneaks !" exclaimed Arthur. "I wish I had been there to help them down again."

"Now, I must introduce you to a Frenchman. If you had been with me at the Exhibition of the Royal Academy for 1862, and had looked in the catalogue for the explanation of a certain picture by Mr. Elmore, R.A., you would have seen these words—

“ ‘Distracted, and nearly destitute, he returned to his native place, to visit his family ; and while sitting by the fire, happening to turn round, he perceived one of his daughters combing her hair ; when an idea struck him, he had found that which was wanting,’ &c.”

“Who was the man, mamma, and what did he want to do ?” said Arthur.

“The man’s name was Josué Heilman, born at Mulhausen in 1796. He had long been trying, among other clever projects of his active brain, to invent a new machine for *Carding* or *Combing* fibre, one that should do as well for flax as for cotton or wool. The little circumstance of noticing that his daughter held her long hair firmly in one hand, while she combed it with the other, is said to have suggested to him the idea of which he was in search. At any rate, he fully succeeded in producing a most ingenious and useful *carding* machine, for which he took out a patent in 1846, two years before his death.

“I must just glance for a moment at the other parallel threads, I hold in my hand.

“In the early part of the eighteenth century, the making of lace by pillow and by hand was a very profitable employment, both in Buckinghamshire and at Honiton, in Devonshire ; but about 1770 a stocking weaver at Nottingham, of the name of Hammond, conceived the thought that the lace he saw on his wife’s cap might surely be done by a *machine* similar to that by which stockings were made.”

“The clever fellow—did he succeed ?” asked Syd.

"I believe not himself, but his thought excited the thoughts of others, and Nottingham soon afterwards became very famous for its 'machine-made' lace."

"I suppose that injured the trade of the pillow lace makers?" said Carrie.

"Yes, it did, especially as a Mr. Heathcoat, in 1809 invented a most complicated kind of loom for making the ground work of net and lace."

"It must have been a difficult thing to contrive," said Carrie.

"Yes, because you see in lace and net, the threads must not only intersect each other as in common weaving, but they must be made to go round each other so as to form holes or meshes, round or square, six or eight sided according to the pattern. The machine of Mr. Heathcoat, called the 'bobbin frame,' is a kind of loom, in which the *warp* threads are placed vertically, and the weft threads pass in and out at right angles to them. Then there are as many shuttles, or *bobbins* as they are called, as there are warp threads, and altogether the machine is extremely delicate and complicated.

Now if I could take you to Derby, I would show you a pile of old red buildings standing by themselves, upon an island or swamp in the river Derwent. That pile is the real 'old Derby Silk Mill,' built by one John Lombe, 155 years ago, and which was still at work in 1844, and perhaps much later. The building was, especially for those days, a very wonderful one. It was five storeys high, and occupied about one eighth

of a mile in extent ; and as the ground on which it stood was nothing better than a swamp, large piles of ash, sixteen or twenty feet long, were driven close to each other, and then covered with a floor of masonry, There was also a large water wheel, at which the people wondered greatly. In this mill William Hutton went to work in 1730, when only a small child of seven years of age, and had to stand on high pattens to make himself tall enough."

"Poor little child," exclaimed Maggie, "how could his parents let him go !"

"You shall read his autobiography some day, and then you will see how it happened.

"From that time we have been able to prepare our silk from the raw material for ourselves, instead of having to depend greatly upon the silk mills of Italy."

"Carrie will be glad to hear that," said Sydney; "she and Arthur are always ready to fight for the honour of auld England."

"I am sorry then to be obliged to hurt their feelings, but the truth must be told, and that is, that the arts of spinning and weaving were much more advanced in France, Italy, and Flanders, at that time than they were with us ; also, that it is to natives of these countries that we are indebted for a great deal of our knowledge.

"You remember the law of religious toleration, called the Edict of Nantes, granted by——?"

"Henry IV., and revoked by Louis XIV. in 1685," replied Carrie.

“Right—that revocation compelled many thousands to leave their native country and seek a home elsewhere. Fifty thousand came to England, and very many of them settled in Spitalfields and established themselves as silk spinners. Others helped to improve our woollen cloth manufactures. We used to send our cloth to be dyed and dressed in Holland, because there it could be done so much better. But in the reign of Charles II., a Netherlander came and taught our people how to dye cloth, so you see we must be humble.”

“Well, it seems strange we could not have found that out for ourselves,” said Arthur.

“Yes, it does, especially as we were famous for this very thing at one period of our history. But the troublous times of Charles I. seemed to have driven away the knowledge and the trade.

“Both Henry VIII. and Elizabeth did what they could to encourage home manufactures. The *knitting* of stockings in the sixteenth century became a domestic employment; of course it was done by hand. But in Elizabeth’s reign a certain William Lee, an M.A., if you please, of St. John’s College, Cambridge, had invented and erected a *frame* for the knitting of worsted stockings. He settled himself first in a village near Nottingham, and afterwards went to London. The Queen, it is said visited him and stimulated him to try and make *silk* stockings by machinery, which he succeeded in doing, 1596-7. People at that time generally wore woollen hose, and as a grumbling

satirist of the times writes, they were 'not ashamed to wear hose of all kinds of changeable colours, as green, red, white, russet, tawney, and else what not'—and worse offence still, 'cunningly knit' as well. The Queen's silk woman, Mrs. Montague, had presented, her with a pair of black silk stockings, made in England, and her Majesty liked them so much that she resolved never to wear woollen ones any more.

"It appears that they knew how to *knit* stockings in Spain before we did in England, for the great merchant, Sir Thomas Gresham, presented King Edward with a pair of long silk Spanish stockings, a present greatly esteemed by the young King. And in the inventory of the wardrobe of his royal father, Henry VIII., mention is made of silk stockings from Spain, evidently kept for state occasions. Now what wonderful improvement in the way of spinning was introduced into England about this time, think you?—nothing less than the *Spinning-wheel*."

"Why I thought people had always used the old spinning wheel," said Maggie.


"No, even the spinning-wheel, that we now look down upon with some contempt, was at this time considered quite a wonderful invention, and an immense improvement upon the spindle and distaff of earlier days. But though new to us in England in the sixteenth century, there is reason to believe it had long been used by the Hindoos."

"Behind again, you see, Carrie," said Syd.

“Now we will stop our ‘Threads’ of the history of weaving at least for to-night, at this point. I think we have unravelled quite enough for you to think about and remember from *our Cambric Handkerchief*.”

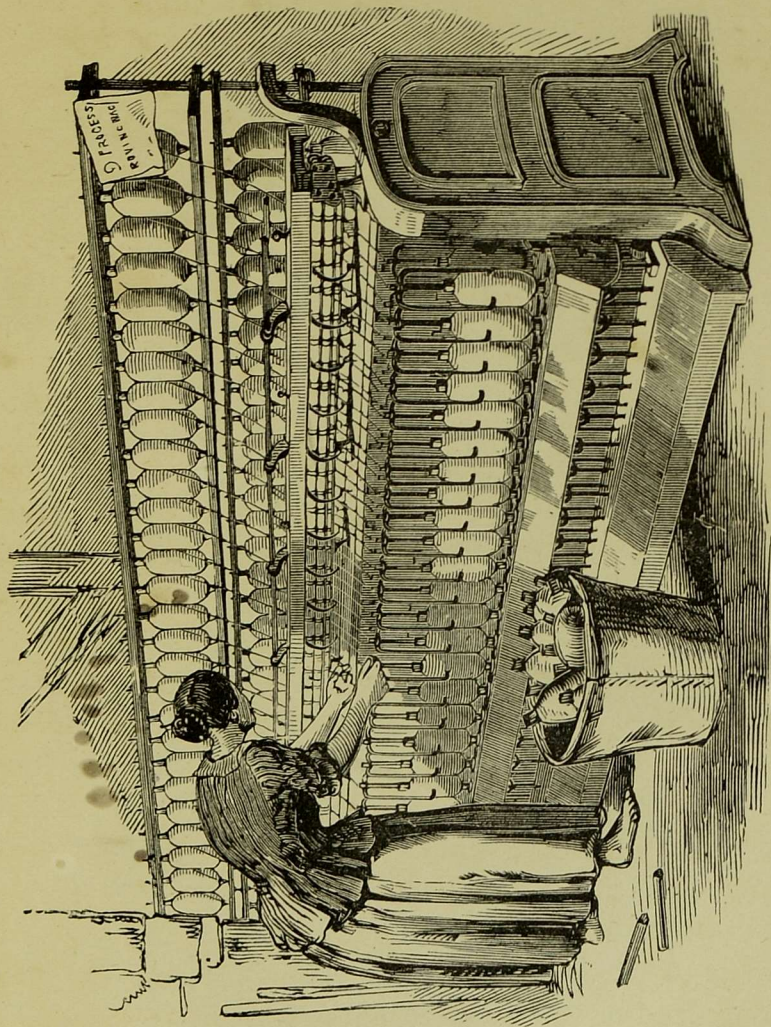


A BRUSSELS CARPET.

“RE you well enough to sail with us in the good ship *Argo* to-night?” said Mrs. Norton, addressing herself particularly to Sydney, who had been suffering much from pain that day.

“Oh yes, mamma; I am regularly jolly now. Papa read me to sleep before he went out, and the pain has quite gone away; so let us begin at once. Are we going to look for the ‘Golden Fleece?’”

“I do not know whether any Fleece that we may find will deserve the name ‘Golden,’ but I propose that we try and get some information out of a ‘*Brussels carpet*,’ and if we follow its threads they will certainly lead us to talk of wool and the art of manufacturing it. You know it is thought, that to obtain that knowledge was the *result*, if not the object, of the voyage of Jason and his daring companions; at least,



ROVING MACHINE. (*See "A Brussels Carpet."*)

that is considered to be the possible fact which was afterwards embodied in fable."

"Stop a minute, please, mamma," said Maggie. "I do not understand what you and Sydney are talking about. What do you mean by the ship *Argo*, and the 'Golden Fleece?'"

"Why, Maggie, I believe you know, if you only think a moment. Have you never heard or read of the 'Argonautic Expedition' undertaken in the very early days of Grecian history? The hero, Jason, and his bold companions are said to have sailed in the ship *Argo*, for which reason they were called 'Argonauts,' in order to revenge the death of his relative, Phryxus, who had been murdered by Æreates, King of Colchis, a country of Asia, east of the Black Sea, and also to recover the Golden Fleece of a certain ram which had belonged to Phryxus. You can follow this 'thread' and find out more about this 'Golden Fleece' at another time. Of course, the possible facts of the case are very difficult to find out from the fable; but it is supposed that the Argonauts brought back with them a knowledge of the art of manufacturing wool."

"Mamma, I cannot help it, but I do not like turning fable into *fact* in that way," said Carrie impetuously.

"Nor I either," exclaimed Arthur; "it knocks all the fun out of the stories—*facts* are such precious slow things."

"I am very sorry for you both," rejoined Mrs.

Norton, smiling. "But if you looked closely at these same *facts* which you call dull, I think you would find enough of romance in them even to satisfy such lovers of it as yourselves.

"Take this fable, for instance. Make it as commonplace as you please, only keep strictly to the truth, as far as we can make it out, regarding the circumstances that belong to the *time* and to the *place*. Suppose it was really only a voyage undertaken for the purposes of trade. Think what a voyage would mean in those early days. Navigation little studied; ships small and cranky; the sea, the Mediterranean, 'the *great* sea,' trackless, boundless; the winds and the waves believed to be under the control of capricious deities, of whom nothing was known, except that they were easy to offend, difficult to propitiate; the land to which they were bound, or on whose shores they might be driven, an unknown land, on which they would meet they knew not what—might be monsters, might be men, would of a certainty be foes. Think of these things, and as many others as you can collect and bring before your mind, and you will feel that a journey in those days, whether by land or by sea, for trade or for war, was something to call forth plenty of daring and courage, strength and endurance, on the part of those who undertook it."

"I never thought about it before," said Arthur "but now I *wish* I had lived in those early days."

"Take courage, Pen," said his mother, laughing at the boy's lachrymose tone. "I have an impression

that there are some difficulties and perils left for you to overcome even in the present day ; such as a few mountains to scale, hostile tribes and savage animals to encounter in Central Asia, or the interior of Africa, for instance ; dangers in Arctic seas, cold, famine, and a few such trifles to endure. But to-night I certainly can promise you no such pleasant excitement, though I hope our quest will not be altogether uninteresting to you."

"I suppose we shall not have to go out of our own country ; we surely have enough sheep in our own land for all the wool we can want," said Sydney.

"The wool from our English sheep is not fine enough for some kinds of material, though it does well enough for worsted goods ; and our farmers cultivate the sheep for its flesh more than for its wool. We import the fine wool for our broad cloth from Germany, and a very great deal of wool comes to us from Australia ; Australian wool being very soft and fine, exceeded by none except the German fleece."

"Don't you think sheep are most stupid-looking creatures ?" said Maggie.

"You are as bad as Buffon, the naturalist, Maggie ; he has not a single good word to say for the poor animal. But I think you are both unjust to it. You must not judge the creature as you see it here, petted and fattened, all things provided for it without any care of its own ; a mode of life that does not tend to make either man or beast remarkably clever. You should see it in its free, wild state ; make acquaintance, for

instance, with the Argali, or Siberian sheep, that loves solitude, and seeks its food with labour from the clefts in the steep rocks, and when attacked shows both sense and courage; then I think you would alter your opinion. And if you were to talk to a Spanish shepherd, who, in jacket and trowsers of black sheepskin, long leathern gaiters, slouched hat, red silken sash round his waist, and *manta*, or brown blanket, slung over his left shoulder, walks day after day in front of his band of ten thousand sheep, and leads them a journey of about four hundred miles in search of fresh pasture, you would gain a very different impression of the character of the sheep from that which you now have."

"How can they take the poor things such dreadful long journeys, mamma?" said Maggie.

"The 'merinos' of Spain are the wandering Arabs of the sheep race, except that they are peaceful instead of warlike. As soon as April comes they cannot settle, and if not watched will leave the plains where they have passed the winter, and start forth alone for the mountains. Therefore these journeys are duly provided for and arranged, and were so as far back as the middle of the fourteenth century. A tribunal called 'The Mesta' was then appointed, which passed very strict laws about these journeys. The sheep were to be allowed to graze on all common lands that lay in their route, and a path ninety yards wide was to be kept for them through the cultivated country; and while the sheep were passing, no one might go upon

these paths. The king was styled the 'Merino Mayor,' so you see the sheep were placed under the special protection of royalty."

"I do not think our English farmers would like to be forced to give up so much of their land to such droves of sheep," said Sydney.

"Neither do I, Syd. I cannot say how far these laws are enforced in Spain at the present time, nor even whether the journeyings are carried on with anything like their former care and regularity. But thus it used to be. The flocks were divided into bands of ten thousand each, and each 'band' had its 'Mayoral,' or chief shepherd, who had fifty shepherds and as many large dogs under him. The best and most intelligent of the sheep were so trained that they understood all the signals of the shepherd. He knew them all by their names, and they knew him, and followed him wherever he went. There was no *driving*, only *leading* and following."

"Oh, mamma, don't you remember, you know——" exclaimed Maggie eagerly, and then stopped as suddenly, blushing deeply.

"Yes, Maggie. I know of what this reminds you. You are thinking of those few verses in the Gospel of John which we read together this morning, and I do not wonder; for no one can fail to be struck with the exceeding beauty and accuracy of the illustration, not only as regards the character of the Chief Shepherd, but also of those *that are led*. To know when, and how, and whom to follow willingly, requires intelligence as well as docility."

"How *knowing* a little about a thing, such as an illustration, helps one to *feel* it. I can't say exactly what I wish, but you know what I mean, mamma," said Carrie, after a few minutes' pause.

"Well, Carrie, I happen to know from my own experience, or perhaps I might not from your statement. I know that thought ever helps to deepen and strengthen feeling, and feeling tends to quicken and brighten thought. You have now been doing a little of that *private* weaving of which I spoke at the beginning of our conversations. But let us return to our immediate subject.

"The fleece of the merinos, both of the German and the Spanish breeds, is said to be extremely fine and soft, and to have good 'felting,' or interlacing properties."

"Oh, let me ask you, while I think of it, mamma—ought mohair and alpaca to be called *wool*?

"Yes; alpaca is the wool of an animal of the llama tribe, a native of Peru; and mohair is the wool of the Angora goat, of Asia Minor. Both these wools were introduced into England about 1836 or 1838, and have since been largely manufactured into many different kinds of fabric."

"And what is done with the wool when we get it?" asked Arthur.

"A great many things," replied Mrs. Norton. "The wool is brought to the factories in different packages, or bags. It is first of all 'sorted' according to its fineness and softness, an operation which requires

and produces great skill and delicacy of touch on the part of the sorter. Then 'scoured,' that is, well washed in a hot liquor, containing lime, ammonia, and soda. After this it is oiled and put into a machine, which tears the fibres completely apart, and spreads them out in a thin fleecy down. This 'scribbling,' as it is called, is next 'carded,' or *combed*, to get the fibres to lie somewhat parallel. The 'band' of wool is then by machinery formed into long 'rollings.' The 'rollings' are made into 'slubbings' (I did not make any of the terms, please to remember), that is, the ends of the 'rollings' are very cleverly joined by the fingers of little children, who go by the name of 'pieceners,' and by means of a machine are *drawn out*, greatly reduced in thickness and slightly twisted."

"Children seem to be able to do a great deal," said Maggie.

"Yes; they are early trained to work, poor little things. But in some factories this last 'slubbing' machine and the children's fingers are entirely done away with, by the use of another kind of apparatus. The carded wool thus drawn out will be next *spun*, and that will be done by the 'mule jenny,' or some similar machine."

"It seems very much like the preparation of flax," said Sydney.

"Yes; there is great similarity in the main principles of the operations. But in the preparation of the fibre of *fine short wool*, such as would be used for

broad cloth, care is taken throughout all the processes to make the fibres cross and recross each other in all directions ; whereas, with the fibre of cotton, flax, and *long wool* for *worsted* goods, every effort is made to get the fibres perfectly straight and parallel.

“ The fibre of wool, especially of short wool, is much stiffer, more twisted and elastic, than other fibres ; and it is owing to this that it *mats* or *felts* together so thoroughly.

“ Now, if it was a piece of broad cloth that was going to be made out of this fine wool from Germany, prepared in the way we have mentioned, it would now be mounted on the loom, and woven in the ordinary way. The loom for a piece of broad cloth will have from 2,000 to 4,000 warp threads.

“ When woven, there will be several important and peculiar things to be done to it. First, it must be ‘fulled,’ or ‘felted.’ The cloth has a quantity of liquid soap put upon it, is folded up in piles, and placed in the ‘fulling stocks,’ a kind of large mill in which there is a great hammer constantly going. By this *beating*, the fibres of wool become so locked into each other that the crossing of the warp and weft threads is almost hidden, and a close fabric is formed.

“ The next process is to *raise the nap*, by brushing the cloth with brushes formed either of wire or of teasel heads. This used to be done entirely by hand, but is now accomplished by machinery. The wires, or else the heads of the teasel plant, are fastened on

to a cylinder, which is made to revolve very quickly while the cloth passes over it slowly.

"The teasel heads are more suitable in one respect, for the purpose of 'raising the nap' than the wire; because the sharp hooks with which the flowers are armed, though strong, will *break* when they meet with any obstacle they cannot overcome, which the wire hooks will not do, but will tear up the fibre and injure the cloth."

"Just like obstinate, pig-headed people, who *will* cling to an opinion if it is ever so stupid," said Sydney, "and never know when to yield."

"The *raised nap* must then be 'cropped' or cut, so that all the threads may be perfectly level; the cloth pressed to give it a satiny look, and a few other small things done to it; and it may then be made up into bales and taken to the market."

"And Arthur may have a new jacket," said Carrie, "for as I can see the crossing of the threads at the elbow, I am sure the *nap is gone*."

"A very remarkably useful application of your knowledge, Miss Carrie," retorted Sydney; "but I doubt whether Arthur will be grateful to you for it. He does so hate new clothes. Now, if you had directed your wisdom on to my poor self, you would have seen that *my* jacket is even more wide awake than Arthur's, having lost its 'nap' in many places, and you would have earned my lasting gratitude."

"Nap or no nap, gentlemen, I suspect your jackets will have to be content with their wearers for some little time longer," rejoined Mrs. Norton, laughing.

"I thought we were going to weave a Brussels carpet, mamma," said Maggie; "and we have made a piece of cloth for coats."

"Quite true, Maggie; but I wanted to say a little about *fine* wool and cloth before we came to *worsted* and worsted goods."

"Is *worsted*, such as this bit of carpet is made of, really *wool*? It seems so hard," said Maggie.

"Yes; the worsted (so called from the town *Worsted*, in Norfolk, where the manufacture was first carried on) is longer and coarser in fibre than that which is pre-eminently styled 'wool,' but both are equally from the fleece of the sheep. The preparation of worsted yarn is very similar to that of other yarn; so we will not stop to talk about it. It is to the *weaving* of our carpet that I want to call your attention."

"I suppose it is called 'Brussels' from having been made first at Brussels?" said Carrie.

"The names given to the different kinds of carpets are very misleading, and sometimes have nothing whatever to do with the place of their manufacture, past or present. For instance, 'Venetian' carpet, as it is called, has never had, I believe, anything whatever to do with Venice. There are carpet manufactures at Brussels, but whether this particular kind first came from that town is more than I can vouch for. In the kind of carpet known as 'Brussels,' you will find that there are not only the *worsted* threads for the warp, but also that there is a *linen web*; that is, that there are linen threads among the warp, and that there is a *linen weft*, or shoot thread.

“There are five sets of coloured worsted yarns woven in between every under and over ‘shoot,’ and these five coloured yarns are brought to the surface just in the order and number necessary to form the required pattern.

“Do you notice the *raised rib* in this Brussels carpet? That rib is produced by inserting a round wire the whole length of the fabric. The warp threads are raised, so as to form a passage, the wire is placed in, and the ‘weft’ thread ‘thrown.’ When several of these wires have been thus woven in, they are drawn out, and the loops left standing. In another kind of carpet, the ‘Wilton,’ the wires are not *drawn* out, but the worsted loops are cut by passing a sharp knife along the grooved edge of the wire. These cut loops, afterwards shorn and dressed, form what is called ‘the pile.’ In some materials with a pile, silk velvet for instance, there are as many as forty or fifty grooved wires in one inch. The *weaving* of our cambric handkerchief, or the cloth for our piece of broad cloth, was a very simple affair compared to the weaving of a Brussels carpet. In the first two cases, the yarn was drawn through only *two sets* of *healds*, one heald raising every other thread. But in ‘figure weaving’—that is, the weaving of any kind of cloth that is ornamented with a pattern of any description—the warp threads are divided among a number of healds. In some cases there are no fewer than thirty-two healds.”

“How can the weaver manage to raise so many different healds? He has but two feet, and if he has

so many treadles, surely he will get confused, and raise the wrong. It must be much worse than playing the organ pedals," remarked Arthur.

"You are right ; there are far too many to be moved by the feet. The healds used to be moved by a system of cords and pulleys, called the 'draw loom.' Of course, it was extremely easy for the 'drawer' who pulled the cords to pull the *wrong* one, and thus derange the whole pattern. But now an apparatus, called the 'Jacquard loom,' is very generally adopted. This apparatus, which is appended to a loom at the upper part of it, is so exceedingly beautiful in its cleverness that I should like, if I could, to give you some idea of the principle."

"Well, try, mamma ; we will do our best to comprehend," said Sydney.

"Suppose," said Mrs. Norton, "I take a row of ten pins from this paper of pins, and press a piece of card against the points of them ; you see all the pins are pushed upwards. If I make holes in the card corresponding in number and position to the points of the pins, and again press the card, what follows?"

"All the points go through the card, and the pins are not moved," replied Carrie.

"Now, I will take another card, with only four holes in it, and press the pin-points ; what then?"

"Why, four pins slip through the four holes, and remain still, while the other six are pushed up the paper ; and I suppose if you had other cards with holes differently arranged, other pins would be moved," said Sydney.

"Exactly so ; and that is just the foundation idea of the Jacquard apparatus.

"A number of cards, formed of thin pasteboard, sometimes of tin, from one to two feet long, and two or three inches wide (of course, the dimensions may vary), are perforated with holes, some more, some less. In each card the number and places of the holes correspond to the number and place of the warp threads that require to be raised in order to form the pattern, and to allow the passage of the shuttle. Each card represents a certain definite part of the design ; and there must be as many of these cards as there are *weft* threads in the pattern. The number of these is sometimes very great, and they will only serve for one pattern."

"But how do they bring the cards to the *pins*, or whatever it is that requires to be moved?" asked Sydney.

"A revolving bar of wood, with four or more sides, each side pierced with holes equal in number to a certain set of needles or wires, is made to move up and down against the *points* of the wires. If all these holes are open, *all* the needle points, as you know, will pass through. But as you wish some to pass, and some *not* to pass, what must you do?"

"Block up some of your holes in the bar of wood," exclaimed Arthur.

"Quite right, and this is done by connecting by threads a number of the cards I have described, and making them pass over this wooden bar. Where there

are holes in the card, the wires pass through ; where there are *no* holes, the wires are pushed up or moved on one side. These needles are connected with other wires that have hooks at their ends, and these latter wires are connected with the warp threads that are to be raised."

"How ingenious it seems," said Sydney. "I should much like to see the apparatus at work."

"I hope you may some day," replied Mrs. Norton. "It is to the working of the Jacquard apparatus that electricity has been applied. Instead of these cards, a metallic paper is used, on which the required pattern has been traced with varnish. Metal, you know, is a good conductor of electricity, the varnish employed is a *non*-conductor. A number of electro-magnetic wires, equal to the number of needles in the Jacquard loom, are so arranged that one of their ends is in contact with a battery, and the other end with this metallic paper. The electric current, as it plays upon this metallic paper, will *pass into* such of the wires as are in contact with the metal, but will *not* pass into those that touch the varnished part ; and the mechanism is so planned that the needle is raised or is not raised according as the electric current passes into it or does not pass."

"There seems to be no end to the inventions and improvements. Don't you think it would be a good thing if people could stop for a little while, just to take breath ?" said Carrie, drawing a long breath herself by way of relief

"I fear that could not be, Carrie, even if it were desirable," replied her mother, smiling. "If you do not think it will quite overwhelm you, I should like to mention two other things before we again take up our history threads. The one is, that in some cases *compressed air* is used instead of *steam* as the driving power, and that by it a great saving in the wear and tear of the machinery has been effected. The other, is an instance of the way in which old material can be used for new purposes. Old rags of woollen fabrics are taken, washed, torn fibre from fibre, mixed with a little new wool, then spun and woven; and the material thus manufactured, called 'shoddy,' is made to serve for druggets and such homely but useful fabrics."

"Well, that is clever and economical," said Arthur.

"Yes; it is one specimen among many of the way in which wise men follow the grand law ever acted upon by the great economist, *Nature*, of gathering up the fragments that nothing be lost.

"Now, we will take up our HISTORY THREADS. It is within the last twenty years that our carpet manufacture has risen to the state of excellence in which it now is. The power loom was not applied so early to the weaving of carpets, especially of carpets that employed the Jacquard apparatus, as it was to the weaving of other fabrics. I believe Messrs. John Crossley and Sons, of Halifax, were the first who used steam power for tapestry printed carpets, and they made it succeed so well that they soon employed it for Brussels carpet with the Jacquard loom. These

were formerly all done by hand, and are now to a very great extent abroad."

"Come, I am glad the Messrs. Crossley and Sons have put us the very first in something, at any rate," said Arthur.

"I do not know that we can claim the honour of being the *very first*, for in 1851 a Mr. Bigelow, an American, exhibited a specimen of power-woven Brussels carpet. But our English manufacturers have made the invention their own by their great improvements and alterations; and in 1862 Messrs. Crossley had produced a loom that could turn out more than double what Mr. Bigelow's could do, and five or six times as much as an ordinary hand-loom could produce. It is said that in England and Scotland there are more than forty thousand people employed in the preparation of the material and manufacture of carpets."

"Mamma, what are *tapestry* carpets? I thought tapestry was something worked with a needle," said Carrie.

"So it used to be in early times; but these tapestry printed carpets are carpets in which, instead of the five sets of different coloured yarns, such as the Brussels carpets have, there is only *one* yarn-thread employed. The separate threads of this yarn have first been *printed* of different colours by passing rollers over them dipped in the various dyes; the order and number of the colours being arranged according to the pattern designed for the carpet. This method does away with

all the complicated apparatus for producing the figure employed in other kinds of carpets."

"Who invented this Jacquard apparatus?" asked Sydney.

"A straw-hat manufacturer—some say a weaver—of Lyons, born 1752, called Joseph Marie Jacquard. His fellow-townsmen showed their sense of his merit by ordering his machine to be publicly broken up, to the great grief of the inventor. Other people were not so foolish, but adopted the idea; and in after days the Lyonese weavers felt ashamed of the ingratitude of their ancestors, and decreed a public 'Homage' to Jacquard. This 'Hommage' was a picture woven in silk by means of his apparatus, representing him in his shop surrounded by his tools. In this silk picture there were 1,000 threads, both warp and weft, in every square inch; 24,000 cards were required for the pattern, and each card was large enough to receive 1,000 holes."

"Well, that was very ingenious and clever," said Carrie. "But, mamma, do you not think a proper, painted picture would have looked better?"

"Most assuredly I do. I think it was a waste of skill. It is a great mistake to try to produce in one material what can be done with far better effect in another. Happily, such ingenious perversions are not very common now. The true principles of art, and the right application of them to ornamental design, are becoming better understood and appreciated. Now, one of the first of those principles is to adapt

your design to the nature of your material and the use it is to serve ; and a picture, such as this one of which we have been speaking, cannot be so well expressed in a *textile fabric* as by other means."

"What's the difference, mamma, between a *design* and a *picture* ? They both represent something or other," said Sydney.

"True ; but I would define a picture to be a representation of some one thing or combination of things, whether animate or inanimate, as they seem to appear to the artist at a certain *fixed time and place*, and under certain circumstances ; while a design, technically speaking, is the arrangement, according to certain rules and principles, of forms and colours, so as to produce a pleasant general effect upon the mind through the eye. If a designer wishes to have rules and principles by which to guide himself, he will find none better than those that are contained in the open book of Nature given him by the Great Artist and Designer. The illustrations all can see ; the rules by which they are governed are known only to those who take the trouble to seek for them. Designers are beginning to do this with patient care ; and one good result is, that we are not often now obliged to walk over the representation of things that were never intended to lie flat, such as pieces of architecture, hard knots, prickly points, bunches of flowers with round stems ; things that, if you saw them lying on the ground, you would most certainly avoid stepping upon. Nor are we now obliged to see upon our walls

pictures of elephants and castles, trees and towers, men and animals, piled one on the top of each other, as they must of necessity be in a pattern that is repeated over and over again on the same flat surface."

"Do you not like representations of flowers upon a carpet or a paper, mamma?" asked Sydney.

"Certainly I do; that is, when the artist who designs them understands what Nature puts upon her walls and floors, and follows her rules and teachings on the subject."

"But, mamma," said Carrie, "flowers grow any way and every way and everywhere; there seems to be no particular rule about it. They are free and natural; there is nothing stiff and regular about them, like those stiff geometrical figures that some people admire so much."

"Indeed! Then I am afraid you have not looked at the pictures very carefully, much less studied the small print of Nature's book. If you had, you would have found out that there are very definite and decided rules in the matter. You would have discovered that the *ground plan*, so to speak, of the way in which the different parts of a plant are arranged is as regular and geometrical as any of those figures you seem to dislike. For instance, you would see that one set of leaves never falls exactly *over* another set; the leaves or petals of a corolla do not fall *over* the sepals, or leaves of the calyx, but *between* them. Then a designer who was also a student, would see that flowers which in nature *lie below the eye* are, as the general rule, arranged

on a circular plan ; their parts radiate from a common centre, as the daisy and primrose, for example ; while those that are intended to occupy an upright position, are on a level with the eye, are formed with two *symmetrical* halves—that is, halves in which the parts repeat each other, only in the reverse way, as our hands do, for instance. I do not mean to say that there are no exceptions to these rules, but merely that these are some of the general principles on which Nature's floral ornaments are designed."

"I will collect a number of specimens of flowers, and bring them home to look at with you, Syd, the very next walk I take," said Carrie. "Go on, please, mamma."

"The designer who patiently studies this book," continued Mrs. Norton, "will learn some of the subtle secrets of Nature's colouring ; will notice how she subdues her tints, and blends her thousand tones into one harmonious whole ; and will not give us in his own creations, a profusion of primary colours, or very violent contrasts of strong colours, one colour pushing unduly forward, and crowding others out of place. For if he does, he produces a sense of unrest and confusion where, especially on a flat horizontal surface, the aim should be to excite the impressions of evenness, breadth, softness, unobtrusiveness, rest, and order ; to which may be added those of cheerfulness or quietness, warmth or coolness, according to the nature of the room to be ornamented.

"But these are 'threads' that, interesting as they

are, I must leave to you to follow out some other time. They will lead you into most pleasant paths.

"The Great Exhibition of 1851 did us all a great deal of good, in showing to us that other nations, more especially Eastern ones, had mastered the principles of colour, and knew how to apply them to decorative art. The Indian shawls and carpets there exhibited were splendid specimens of the good effects of understanding the laws of colour; while the methods by which these results were secured were often curiously subtle. In India, carpets are made entirely by hand. The loom is very simple, and for some kinds is arranged vertically. The weaver ties on to the yarn thread different coloured worsteds; then raises some of the warp threads to form a passage for the shuttle, which he passes backwards and forwards, and makes the whole tight.

"There was an exceedingly beautiful carpet from Cashmere, at the Great Exhibition, made entirely of silk, and which had, I have read, ten thousand *ties* to the square inch.

"Rugs in our European looms are often made in a similar way, the coloured worsteds being tied upon the vertical warp threads by the quick and clever fingers of young girls."

"How strange it seems that Eastern nations should know so much more than we appear to do about colour and such things," said Sydney.

"Their knowledge is in great measure what we call '*intuitive*;' that is, knowledge which comes without being consciously sought for," replied his mother.

"I wish knowledge would come to me in that kind of way," exclaimed Arthur.

"I have not the slightest doubt you do, Pen; but you must be content, like the rest of us, to get knowledge as the reward of patient search and diligent labour.

"But I was going to add that the carpets made by the Turkestan women and girls, in Central Asia, are also remarkable for the purity of their taste and the excellence of their texture.

"I dare say you know that at one time carpets were quite luxuries in England, to be indulged in only by the very rich. A king, perhaps, might have one at his bedside; but, judging from the drawings that have come down to us from the Middle Ages, carpets were reserved for the high altars in churches; occasionally they may be seen spread before the throne."

"How strange it would seem now to see our rooms without carpets," said Maggie.

"Yes, indeed. English people are not fond of the look of bare boards. The making of tapestry carpets was introduced into England by two French workmen in 1750. Soon after, a Mr. Moore set up a manufactory, and obtained a premium in 1757 from the Society of Arts for the best imitation of a Turkey carpet. But these carpets were very expensive."

"What did people do when they had no carpets? Had they nothing on their floors?" asked Maggie.

"Most likely they spread straw or rushes upon them; and the first attempt towards making a carpet would be to——?"

"Plait the rushes and make mats," replied Maggie.

"Yes; as the Japanese do to this day. The soft, elastic mat which they make from the soft rush, called the *Juncus effusus*, and which is generally about two yards long and one broad, with a narrow blue or black border, and often three or four inches thick, serves as well for beds as for carpets.

"In olden days, in the north of England, the floors of the churches were frequently left unflagged, and once a year the inhabitants of a village or hamlet would wander forth among the fells, and gather rushes with which to strew the floor.

"'T'Reysh Bearin',' in Westmoreland, was quite an important event, from which the villagers used to reckon their ages and the main epochs of their lives. A memorial of the old custom is still kept up at Grasmere and Ambleside, though, of course, the present ceremonies differ in some of the main features. On the Saturday evening preceding the appointed Sunday, children, accompanied with a band of music, carry round the village a number of garlands and devices of all kinds, formed of wood, and covered with moss-roses and rushes. These are then deposited in the church, and remain there over the Sunday. Lovely little Grasmere, celebrated not only for the beauty of its hills and the quiet of its lake, but for being the resting-place of William Wordsworth and Hartley Coleridge (son of *the* poet, Samuel Taylor Coleridge), has its church decorated with these quaint devices every third Sunday in July. Ambleside has

the same ceremony a week later. There are special sermons preached, and special hymns sung on the occasion ; thanksgiving hymns to Him

‘Who gives us sun and showers,
To cheer our hearts with fruitful days,
And deck our world with flowers,’

to quote from a ‘Hymn for the Rushbearers,’ which a friend sent me the other day. Some people think that the custom is as old as the age of Gregory IV., who recommended that when a church had been taken from the Pagans, the anniversary of its dedication to Christian worship should be celebrated with similar solemnities and pleasant festivities.”

“What a pretty sight it must be,” said Maggie. “If we go to the Lakes this summer, mamma, *do* let us be at Grasmere in time for it.”

“Very well ; we will try. But we have wandered a little from our tapestry carpet’s thread.”

“Oh no, mamma ; it has only been a weft thread of another colour,” said Sydney.

“And we can easily drive it close up to the preceding ‘shoot,’” said Carrie.

Mrs. Norton smiled at this application of their recently-acquired knowledge, and resumed : “You have heard of the famous ‘Gobelin tapestry,’ but perhaps are not aware that the name comes from one *Giles Gobelin*, who, in the reign of Francis I., discovered a beautiful *scarlet* dye. The colour went by his name ; and not only so, but his house in Paris and the river he made use of were called ‘Les Gobelins.’

Louis XIV., in 1666, established a school for drawing, and a manufacture for fine tapestry, in the quarter where the dyer had lived; and hence the application of the name. The art had been brought into France by Henry IV. He procured workmen from Flanders, and established a manufactory at Chaillot, not far from Paris, which went by the name of the 'Soap House;' *why*, I cannot say."

"Then the Flemings knew how to work tapestry before the French did?" said Arthur.

"Yes. The term 'tapestry' ought not to be restricted to carpets, as it equally applies to a 'hanging' or covering. It is a kind of cloth made of wool and silk, and used to be done entirely by the needle. The art is said to have been introduced into Europe by the Saracens, and they most probably learned it from India and Persia; for it is certain that in these countries carpets were made and used long before they were by Western nations.

"I have read that the first workmen in the art were called in France 'Sarazins,' and the term 'Sarcenet' applied to the material. How it was that the Flemings came to know and practise the art before the French did, is more than I can tell you; but as early as the fourteenth or fifteenth century the art of weaving by loom, in the '*Haute Lisse*,' or 'High Warp style' (that is, with the warp arranged vertically, instead of horizontally), was practised in Flanders, and perhaps also in our own country; for at one time *we* were famous for our tapestry productions. Then, also, lace and

silk were manufactured in Italy before France had acquired the arts, for Mary de Medicis, the wife of Henry IV. of Navarre, introduced lace-making from Venice; and, in 1480 Louis XI. brought workpeople from Italy, and established a manufactory for silk at Tours."

"And how did *Italy* become so clever? where did she get her knowledge from, I wonder?" said Sydney.

"From Greece," replied Mrs. Norton. "In 1147, Roger I., King of Sicily, sacked the cities of Athens and Thebes, and brought away a number of the inhabitants, and settled them in Palermo, where they established manufactures; and from thence the knowledge soon spread over Italy."

"Well, mamma, you see there is great, or at least *some* good in war," said Arthur. "It makes people go to other countries, and then they take their knowledge with them."

"Emigration and colonisation are good things, no doubt, Pen; but I do not know that it is desirable to kill, and to plunder, and to burn down cities in order to procure these results."

"Now, unwind the silk 'thread' a little further, and let us hear how *Greece* came by her knowledge," said Sydney.

"Then I think we had better follow the 'thread' all the way back into China. You all know that silk comes from the silkworm. The little creature is a *bona fide spinner*, for by a dexterous movement of its mouth and front legs it *twists two distinct filaments*

into one, and thus spins out an unbroken thread of about three hundred yards round and about itself, till it is entirely enclosed within its *cocoon*, or nest, which thus becomes at once its shroud and temporary tomb. Now, for a very long time—how long, history does not tell us—the Chinese were the only people that possessed this little spinner, and knew how to rear it; and being Chinese, they, as you may suppose, carefully guarded this knowledge from all the rest of the world. But in the sixth century, two Persian monks, who were sent as missionaries, managed to secrete some of the eggs in a hollow cane. They brought them to Constantinople, and sold their secret to the Emperor Justinian. These eggs were carefully hatched by means of artificial heat, and the worms fed on the leaves of the wild mulberry; and from these few eggs have descended the myriads that have since been reared in European countries—Greece, Italy, France, and Spain. For many years the Romans alone had this knowledge; but by degrees it spread, and then for six hundred years *Greece* was the chief seat of the manufacture and source of supply of the raw material to other nations. After that Italy became exceedingly famous both for rearing the animal and manufacturing the thread. So highly was the trade esteemed, that in the fourteenth century a Venetian noble might, if he pleased, engage in it without degradation to his nobility; just as he might be a druggist or a glass manufacturer, and yet hold his rank.

“Now, let us go back to the reign of Henry VIII.,

and the introduction into England of the spinning-wheel."

"How did people spin without it?" said Maggie.

"They used the spindle and distaff. The distaff was a piece of wood three feet long, on which the carded wool was wound; the spindle, a piece of wood about one foot long. The distaff was held under the left arm. The end of the wool was attached to the spindle, and as the fibre was drawn from the distaff, a twist was given to it by the thumb and finger of the right hand. When such 'a length' was drawn out that the spindle touched the ground, the twisted thread was wound up and secured upon the spindle, and the work begun again."

"That must have been simple, easy work enough," said Arthur, "but rather dull."

"Our woollen manufacture," continued Mrs. Norton, "was very poor during the time of Henry VIII., perhaps owing to the unwise laws made about it; but during the reigns of Richard II. and Edward III. the woollen and worsted trade flourished greatly. Our British wool was thought much of, and fetched such high prices abroad that it was sometimes used instead of gold, when gold was not easily forthcoming."

"Edward III. was glad to procure from his Parliament a grant of twenty thousand sacks of wool, for he was greatly in want of money, and had pawned everything he could, even his own and Queen Phillippa's crown."

"What a shame to pawn his *Queen's* crown! He

might have been content with pawning his own, I think," exclaimed Arthur.

"True; but the game of war is a costly game at which to play, and inordinate ambition makes people reckless of the means they employ to gain their ends. But, however, Edward III. was anxious to promote our English trade, and he encouraged a number of Flemish and Dutch emigrants to establish manufactures in England, and to teach our people; which they did, greatly to our benefit. Many Flemings settled at Halifax and the neighbourhood, and it is declared that traces of their dialect still remain in that part. One 'Kemp,' a native of Flanders, established a manufacture at Kendal, and helped to earn for that town the reputation it long enjoyed. 'Kendal green cloth' was early celebrated. It is said that, not so very long ago, there were actually descendants of this Kemp living at Kendal, and engaged in the same trade."

"Well, it seems very strange that we English always require to be taught first by others before we can get started on our own account," exclaimed Arthur.

"How exceedingly clever these Flemish people must have been; they always were ahead of other nations," said Sydney.

"Yes; and not only were they so forward in all useful practical arts; they were also renowned for their attention to *high art* and for their illustrious artists. In this very century, Hubert Van Eyck, one of three celebrated brothers, may be said to have invented the

method of *painting in oil*, and of using a colourless varnish, by which he conferred a great boon upon all artists. But what will our redoubtable English knight feel when he hears what an old writer says respecting the clothiers before the time of Edward III. Listen, Pen. He says they 'knew no more what to do with their wooll than the sheep that weare it,' and goes on to declare, that it was a very good thing for the Flemings themselves, seeing that the richest yeomen in England did not disdain to marry their daughters to them. Indeed, the very commencement of the wool manufacture, *as a trade*, in England, is said to be owing to some Flemings who were driven from their own country during the reign of William the Conqueror by an inundation of the sea, and who begged permission from Queen Matilda—herself a native of Flanders—to settle in this country. William allowed them to do so in the neighbourhood of Carlisle, but Henry I. removed them into Pembrokeshire.

"But, for your comfort, I may tell you that we were from very early days clever in spinning and weaving wool for home purposes, if not in the manufacture of it on a large scale. In fact, the art of spinning was looked upon as a necessary part of a 'polite education.' All spun, from the Queen on the throne to the cottager. The mother of Alfred the Great was noted for her skill in the art, and she was, as you know, a highly intelligent woman. The term 'spinster,' which is still the legal definition of all unmarried females, remains as a proof how very general the occupation of spinning was at one time."

"Queen Matilda must have been very clever with her needle. Did she not work a great deal of tapestry?" asked Carrie.

"Yes. It is generally believed that much of the Bayeux tapestry—so called because it is preserved in the cathedral of Bayeux, in Normandy—was done by her queenly fingers. All noble ladies were clever in those days with their needles; and to this Bayeux tapestry we are indebted for a faithful representation of the habits, armour, and dress of those times. I have read that this tapestry is 212 feet long, and worked in coloured worsteds like a sampler."

"Well, that was worth doing then," said Maggie. "I am glad it is mentioned in that pretty riddle upon the needle which is in *Little Folks* for January."

"Arthur will be shocked to hear that in the fourth century *men* took to weaving. An ancient writer deeply deploras it as a sign of the degeneracy of the times."

"I agree with him, whoever he was," said Arthur. "You can't fancy a brave Roman doing such a thing."

"Not a Roman soldier, certainly, in the early days of Roman conquest and glory; but it strikes me that as wool was the *only*, or chief material used for dress, that the Romans must have had a great deal to do, both as a public and private occupation, with the manufacture of wool. *Silk*, as a material for dress, was looked upon as effeminate and unfit for men's use, until the later days of some of her weak, luxurious emperors. In fact, the Romans were quite at home

in the processes of scouring and preparing wool, and used fuller's earth for cleansing, sulphur for bleaching, and teasels for raising the nap, as if they belonged to our nineteenth century civilisation. On the walls of a building at Pompeii there was a painting of a 'Fullonica,' or scouring house, in which many of the processes were clearly depicted."

"Then, of course, the Romans taught us poor, ignorant Britons when they conquered us?" said Carrie.

"They certainly gave us the benefit of their knowledge in that, as in other things; but they did not find us so ignorant as you profess to believe, Carrie. There is ample testimony from Roman authors to prove not only that the *Gauls* knew well how to dress, spin, dye, and weave wool, but that the Britons—at least those who lived in the southern part of our island—had copied their neighbours. I need not remind you, I think, that spinning and weaving were the usual occupations of Grecian ladies of highest rank."

"Stop, mamma," exclaimed Maggie; "I can give you a 'thread.' I am learning the 'Parting of Hector and Andromache,' and I know he said to her—

'No more, but hasten to thy tasks at home;
There guide the spindle and direct the loom.'

"Right, Maggie. Now, a 'thread' from you, Carrie. I know you have lately been reading Pope's translation of the 'Odyssey.'"

"I know of whom you are thinking, mamma. Of poor Penelope, who did not know what to do with

her rude lovers while she mourned for her lost Ulysses; and so she made them promise to wait until she had finished the web she was weaving, and then used to undo at night all she had done in the day."

"Yes, till some sneak of a servant betrayed her. I heard you reading that to Syd the other evening, Carrie, though you did not think I was listening."

"True; and the expression 'Penelope's endless web' has passed into a current phrase to denote any thing that seems never likely to come to completion. But there is another instance you might mention. Do not you remember that, though the royal maiden Nausicaa left her room at 'rosy dawn,' yet that, early as she was, she found her mother and her maidens already at work?

'The Queen her hours bestowed
In curious works; the whirling spindle glowed
With crimson threads, while busy damsels cull
The snowy fleece, or twist the purpled wool.'

"Then they knew how to dye the wool in those days. You have said nothing about dyeing, mamma," said Carrie.

"No; that subject I hope to take up another time. Weaving, with the Greeks, was quite a trade, as well as a domestic occupation. They knew not only how to dress and dye wool, but also how to 'mount the loom;' that is, as you know, to separate the warp threads into two or more groups."

"Just as we do now with the 'healds,'" said Arthur.

"Yes. They could also produce variegated patterns,

by having the warp and weft of different colours. They were generally of different *wool*, and sometimes the weft was made of silk or of gold for rich and highly ornamented goods. Minerva was the patron of these arts, just as St. Blaise is the patron saint of the modern woolcombers."

"St. Blaise? I never heard of that saint," said Carrie.

"Nor had I either, Carrie, till the February of this year, when I read in some newspaper that the woolcombers of Bradford had on the 3rd of February, the anniversary of the saint's coronation, made known their intention to profit by the 'nine hours movement,' as it is called."

"Then I know you have hunted up the saint, and can tell us about him," said Sydney.

"There is not very much to tell. St. Blaise was an Armenian Bishop, who was put to death about 316 A.D. He established an order of knighthood, partly military, partly religious, and—which is more to our purpose—he is said to have invented *the wool comb*."


"I think it is a good thing these old Greeks were not able to exhibit at our exhibitions. They would have beaten us, I believe," remarked Sydney.

"The Jews must have been well acquainted with these arts of spinning and weaving. You remember, in Solomon's description of the virtuous woman, the woman of clever brains and warm heart, whose price he declares to be 'beyond rubies' (partly, I always fear, from the scarcity of such women) it is stated,

that she not only spins home dresses for her family, but designs and embroiders tapestry, coverings, carpets, and hangings, rich and ornamental, for her house. And when the Tabernacle was in course of erection, it is said that 'all the women that were wise-hearted did spin with their hands;' and of others, that they 'were filled with wisdom to engrave and embroider, and to weave, and to design.' There are very many allusions in the Bible to woven and embroidered fabrics of *linen* and *wool* and *silk*; but there is no mention of cotton, I believe, as a material. It appears to have been unknown, or nearly so, to both Jews and Egyptians. The flax of Egypt, and the linen cloth woven from it, were famous in very early times. We can form a tolerably clear idea of the kind of loom used, from the sculptures on the tombs at Thebes. Rude and simple enough it appears to have been; yet the material made by it was, in some instances at least, exceedingly fine in texture, judging from specimens found in mummy cases. The yarn was remarkably well spun. The warp thread was sometimes even four times as thick as the weft, which is quite contrary to modern practice. Herodotus says that *men* wove in Egypt. I neither vouch for the statement, nor for its accuracy. I simply mention it for Arthur to settle it with the Father of History.

"And now I think that with Egypt, we must wind up our outline history of the arts of spinning and weaving. At any rate, I must not unravel any more Threads for you from a Brussels Carpet."

A PRINT DRESS.

“HAT are you going to unravel for us this evening, mamma ?” asked Carrie, when they were again assembled.

“I propose to-night to draw out a few ‘threads’ from a most simple, unpretending article, and one that is so wholly feminine in its use, that I fear the gentlemen of our party may be inclined to despise it. It is nothing more than a Print Dress, or at least, a piece of one.”

“It is all very well to speak so humbly, mater,” said Sydney, laughing ; “but I do not quite trust you ; your ‘common objects’ and your ‘simple threads,’ lead us into uncommon paths, and through rather difficult places.”

Mrs. Norton laughingly protested against being judged before trial, and remarked, “I have no doubt you all know of what fibre this dress is made, and why it is called a *print* dress ?”

The answers were not so ready as might have been expected in such a simple matter. Carrie hesitatingly said, "Was it not made of cotton?" and Sydney observed that he supposed it had been *printed* in some way or other, but he did not know how.

"You are both right ; though your knowledge seems unable to run very far alone."

"It is weak, and wants guiding ; let us lay hold of some of your 'threads,' mamma, and then we shall get on famously," replied Carrie.

"This print dress, is certainly made of the fibres of the cotton plant. This plant is not a native of Europe, though it is cultivated in some southern European countries. There are many species, and innumerable varieties of the plant ; and the leaves, flowers, pods, seeds, and filaments, are found to vary considerably. It will, perhaps, be sufficient for you to remember that cotton growing plants may be divided into the *shrub*, the *herbaceous*, and the *tree cotton*. The 'shrub' cotton somewhat resembles our currant bush. In very hot countries, it becomes perennial, and with care may be brought to yield two crops in a year. The 'herbaceous,' the *Gossypium herbaceum*, is the plant most generally cultivated. It is an annual, and grows to the height of eighteen or twenty inches. The flowers are pale yellow, with a purple centre. The leaves are divided into five lobes, and are a fine, dark, glossy green. The pod, about the size of a small walnut, is triangular, and divided into three cells and fastened ; to the inside coating of these cells are a number of vege-

table hairs or filaments which we manufacture into our calico, *i.e.*, cotton cloth. When the plant is mature, the pod bursts and shows a white or yellowish ball of down, divided into three locks, one lock to each cell."

"How pretty the white, soft balls must look among the dark green leaves," said Carrie.

"Yes—and it must be a pretty sight, I should fancy, to see the women and children carefully gathering the light, downy cotton in which the seeds are enclosed. The 'picker' requires 'a long hand, with loose fingers and a ready mind,' says one writer on the subject."

"I am afraid yours would not do so well, Maggie," said Carrie, with a side glance at her own remarkably well-shaped hand.

"No, I am sure it would not," replied Maggie good naturedly. "But, mamma, I always thought cotton came from a *large tree*."

"You are thinking, perhaps, of the gigantic *cotton-tree* found in some of the large tropical forests. But that belongs to another family, and though a splendid object to look at, is not valuable for its cotton produce. Then there is the *Gossypium arboreum*, which, if left undisturbed, will grow to the height of fifteen or twenty feet, and is a true cotton-bearing tree. The cotton from it is much esteemed on account of the length and fineness of its fibre; the filaments varying from half to one and three quarters of an inch; and on the length of the fibre depends, in great measure, the value of the cotton in the market. That which is less than an inch

is called 'short stapled;' that above an inch 'long stapled.' The 'long stapled' fibre, if looked at under a microscope, appears to be flat and ribbon-like, and to have a slightly spiral form. Fibres that have this delicate spiral are more elastic than those without it, and are, therefore, more easy to spin.

"The cotton cultivated upon the small islands on the coast of Georgia is thought most highly of by cotton merchants. It goes, in the dialect of the Liverpool papers, by the name of 'Sea-Island Cotton;' while that grown inland, and upon a higher level, is called 'Upland-cotton.' So you will now understand those terms when you meet with them, or hear them."

"What is done with the cotton, mamma, after it is picked?" asked Maggie.

"Both cotton and seeds are first well dried in the sun. The next thing is to separate the seeds, and any portion of the husks that may have been gathered, from the fibre. This is a difficult and important business. With most, but not all, of the American cotton, this is now effected by a very ingenious machine, called the 'Saw-Gin;' a machine which has a wooden cylinder fitted with sixty or even eighty iron saws, with very sharp teeth. One machine, with eighty saws, and with only one man to attend to it, can clean five thousand pounds of seed-cotton in a day. A man working simply with his hands, could scarcely clean one pound a day. The invention of this machine is said to have caused an immense increase and improvement in the cotton trade of America.

"The cleaned cotton is then pressed and packed in bags or bales, containing on an average about three hundred pounds each, and sent off to Liverpool and wherever it is wanted."

"Once in Liverpool, and what then?" asked Sydney.

"I suppose it will have a great deal to go through."

"Yes, indeed, but I need not detain you by going through the different processes, because they are similar to those we have already talked about when unravelling our 'cambric handkerchief' and our 'Brussels carpet.' The fibres will, of course, have first to be well cleansed and torn apart—then *carded*, or combed;—made into continuous *bands* or 'slivers'—these, made into 'drawings'—the 'drawings' still more and more attenuated and drawn out, till they become 'rovings'—and the rovings *spun* into yarn. The yarn will then be 'warped' and 'beamed,' the 'loom mounted,' and our cotton yarn woven into the textile fabric called calico or cotton cloth."

"And now we are ready to do something more to it; *print* it, I suppose?" said Arthur.

"Nay, there is a great deal to be done before we shall be ready to do that to our cloth. When our woven cloth is taken down from the loom, it is what you and I should call rather yellow-looking stuff. The manufacturer terms it 'grey cotton.' This *grey* cotton must first of all be 'singed, *i.e.*, passed over heated copper to take the fibrous nap from it. After that five hundred pieces, each piece consisting of twenty-eight yards, will be sewn together, end to end, making a length of——?"

"Fourteen thousand yards," answered Carrie and Sydney in a breath.

"This length of cloth has then to be washed and steeped, and boiled, times almost without number. It will be washed in water; steeped in soda-ash ley—a process called 'ashing' it;—boiled in lime;—'chemicked,' *i.e.*, steeped in a weak solution of bleaching powder, or chloride of lime; and 'soured,' or steeped in a bath of sulphuric acid."

"Oh, dear me," said Maggie, "What a set of odd names; but especially that '*chemicked*' one."

"'Chemick' and 'chemicking' seem to be common words in some parts of Lancashire to express the products and processes of chemical work. Poor old Mrs. Smith told me the other day that the 'chemick' made her cough 'that bad she could na bide still, night nor day.' She meant some of the gases from the large alkali works in her neighbourhood. Certainly chlorine gas, to a weak throat and chest, is an exceedingly disagreeable and hurtful thing to have as a frequent companion; but as an occasional visitor, it is by no means bad: for it is such an excellent purifier and disinfectant. Then it is one of the most useful and powerful of bleaching agents, being able to drive away almost all the colour from all kinds of fabrics."

"I wonder *how* it is, and *why* it is, that it can do so," said Carrie.

"Really, Carrie," replied her mother, "that is more than I can explain to you. Chlorine has, I believe, a great affinity for, that is, a great liking to unite with,

hydrogen, and takes it away from other combinations ; so that it acts the part of a general destroyer or decomposer of previously existing compounds containing hydrogen.

“Chlorine is not the only agent employed in bleaching. Sulphurous acid is also a good bleacher. Wool is whitened by exposing it to the fumes of burning sulphur. The sulphur, as it burns, takes oxygen from the air, and forms sulphurous acid. Chloride of lime, as a bleacher, was not generally used before the beginning of this century.”

“How did people manage ; was there no *white* calico or linen ?” asked Maggie.

“Oh, yes, but the cloth required several weeks exposure to the air before it became whitened. A great deal of our linen cloth used to be sent in the spring of the year to the grassy plains of Holland, there to stay till the autumn. Hence the term ‘Hollands’ still applied to some linen fabrics. Now, if our piece of cotton cloth is to remain *white*, it will only require to ‘be calendered ;’ that is, passed between heavy rollers to give it a smooth surface, and then to be ‘starched.’ Sometimes the ‘starch’ is mixed with porcelain clay, which gives it that peculiar stiffness known by the name of ‘dressing,’ and at which you grumbled so much the other day, Maggie.”

“Well, mamma,” replied Carrie, “you know how wretchedly hard it makes the calico for working ; and it washes out, and then the calico is as stupidly limp as it was stiff before.”

"But, mater, we do not want our calico to be *white*, we want you to dye it and print it for us," said Sydney.

"I will try, and do what I can for you," replied Mrs. Norton. "If the cloth is to be all of one colour it will be steeped in a solution of alum, and passed through a solution of gall, and then washed and dried; all of which are elaborate processes, though I pass them over thus briefly. Then the cloth may be *dyed*, by being dipped into the 'dye-beck,' or vat, full of the required colour.

"And, now that we have reached the actual process of *dyeing*, I feel as if I were standing outside a cave in which are hidden treasures upon treasures of delightful knowledge, and yet had not the magic words that could open it for you. If I were but able to explain, or could give you eyes wherewith *to see* the hidden, wonderful changes that go on as one substance after another is applied to the cloth, you would think I was a veritable magician, or at least a weird alchemist who ought to, or might have been, hooted and worried to death in the olden days."

"Ah! mater, did I not say that your '*simple threads*' would lead us into strange and perplexing places; and here we are, waiting for admission into the black den of some wizard or other a thousand years old!" said Sydney.

"Not quite so far or so bad, Syd," replied his mother, laughing. "But indeed the wildest dreams of the alchemist, and the most surprising wonders said

to have been effected by wizard wand, are as nothing compared to the transformations that take place every time a piece of material, be the fibre what it may, is subjected to the process called *dyeing*. And yet these 'transformations' are the result of no caprice, the produce of no necromancy; they are simply the results of the working of chemical affinities as unchangeable as they are intricate, as beautiful as they are wonderful. Let me read to you what an accomplished scholar and finished gentleman thought and felt upon this same subject nineteen hundred years ago:—"They (the people of whom he is speaking) take white cloths, and apply to them, not tints, but certain drugs which have the power of absorbing or drinking in colour; and in the linen so operated on there is not the smallest appearance of any dye or tincture. These are then put in a caldron of some colouring matter, scalding hot, and, after having remained a time, are withdrawn, all stained and painted in various hues. This is indeed a wonderful process, seeing that there is in the said caldron only one kind of colouring material; yet from it the cloth acquires this and that colour, and the boiling liquor itself also changes, according to the quality and nature of the dye-absorbing drugs which were at first laid on the white cloth."

"That is Pliny's account of the mysteries of the art of dyeing as practised by the Egyptians, and it would do very well for a description of the results of the modern art of these days. Do you clearly see, Maggie, what it was that seemed so wonderful and strange to Pliny?"

"I think I do, mamma, but"—answered Maggie.

"It was simply this," continued Mrs. Norton, "that two pieces of *white* cloth, apparently just the same, should be put into one and the same caldron, in which was only *one kind of colour*, and yet that the two pieces should come out dyed of *different* colours."

"Yes; but something had first been done to the two pieces of cloth, had it not?" said Carrie.

"True; but the fact that two different, perfectly colourless 'drugs,' as he calls them, had been first applied to the pieces of cloth, does not of itself explain the mystery; though it may suggest the 'thread' that would lead us, were we clever enough to follow it, within reach of the explanation."

"A regular witch's caldron I think it must have been," said Arthur.

"The 'caldrons' of the present day are still more mysterious," said Mrs. Norton, smiling; "for a piece of cloth might be dipped, after being prepared, into two solutions of substances that were both *without colour*, or very nearly so, and yet the result might be that it itself would come out *coloured*. Say, for instance, that you dip a piece of cloth into a solution of a substance called bichromate of potash, and then into a solution of another substance called acetate of lead, and the cloth would be dyed a distinct *yellow colour*. Now, that particular colour was not in the one nor in the other of those solutions; and that yellow dye, or the substance that has that yellow look upon the piece of cloth, and which goes by the name of *chromate* of

lead, is a *fresh-made compound*; it was not *there at first*."

"Then how ever did it get there at all?" exclaimed Carrie and Sydney in a breath.

"It has been formed by the breaking up of two sets of partnerships, and the setting up of a new and distinct partnership. The bichromate of potash is a chemical union of chromic acid and potash; and the acetate of lead, a union of acetic acid and lead. Very well. The cloth, we said, was dipped in both. Then came the dissolution of partnerships. The chromic acid *preferred* to unite with the lead, so left the potash, joined itself to the lead, and formed *upon the cloth* a new compound, called chromate of lead, which has a yellow colour. Now, all this movement, this change of places among the elements composing these substances, goes on surely, silently, secretly; no ear can hear, no eye can see, yet it goes on."

"The dyeing 'caldron' beats the witch's caldron in its marvels," said Carrie.

"Yes, indeed, just as the chemical cave, yclept a laboratory, has riches greater and treasures more valuable than any that Ali Baba's cave contained; and its 'Open Sesame!' may be learned by all who really seek to enter in.

"Maggie," resumed Mrs. Norton, after a little pause, "do you remember what happened to your doll's frocks that you dyed some year or two ago?"

"Oh, yes, mamma. I was so disappointed. I had dipped them into something cook was boiling—logwood

I think she said it was—and they came out such a pretty colour ; but the first time I washed them every bit of colour went out.”

“ Yes ; the colour was not ‘fast’—*i.e.*, fixed into the cloth. You should have prepared your dresses by dipping them into some of those substances which Pliny calls ‘drugs,’ and we, in these days, style ‘mordants.’ ”

“ Whatever can they be mamma ? ” said Maggie, with her eyes very wide open.

“ Nothing so very terrible,” replied her mother, smiling at her look of alarm. “ ‘Mordant,’ from *mordere*, to bite, is only a term given to a class of substances that help to keep the colour fixed upon the cloth. These substances have an affinity *for the cloth* and also *for the colouring matter*. ”

“ And so, I suppose, they act as *mediators*, and bring about a union between the cloth and the colour,” said Sydney. “ But why are they called ‘mordants’ ? What have they to do with *biting* ? ”

“ The French dyers gave this name to them because they thought they had a corrosive action on the pores of the cloth, by which they became widened, and the colour was the more readily absorbed. There are not so very many substances that are properly to be called *mordants*. Compounds of alumina, oxides of iron, tin, chromium, and certain *fatty* substances possess this double power of uniting with cloth and colour.”

“ I suppose there are a great number of things that

will *dye* the cloth?—I mean if it is first prepared,” said Carrie.

“Yes. The greater part are products of the vegetable kingdom, such as aloes, barberry root, Brazil-wood, indigo, logwood ; madder, from the large fibrous root of the *Rubia tinctorum* ; quercitron, turmeric, woad, and others.

“A few are from the animal kingdom ; such as cochineal, the small insect which inhabits some species of cactus, and from which is extracted the brilliant dye carmine ; kermes, an Arabic term for ‘little worm,’ a dye procured from the dried bodies of the female insects that feed upon the leaves of the prickly oak, and upon the roots of some other plants. These two dyes are principally, if not entirely, used for woollen and silk fabrics. Then we also possess dyes procured from the mineral kingdom, which were unknown to the ancients, such as the salts of copper, iron, manganese, and other metals.

“I am afraid I have lingered far too long over the *chemical* part of our work ; but it is so interesting (the one-thousandth part has not yet been told you), and I thought I should like to make you anxious to know more.”

“You always manage to do *that*, mamma,” said Carrie.

“Now, let us try and *print* our calico ; that is, impress upon the cloth one or more colours in different *definite* shapes or forms, so as to produce a *pattern*.

“The old way of applying colour to particular parts

of cloth was by 'block printing.' The design, either the whole or a part, was first drawn on blocks of sycamore or pear-tree wood, and then engraved ; so that the parts which were to be printed on the cloth were left raised, and the other, or the ground, cut away. The piece of cloth to be printed was laid upon a table covered with a blanket. A child, who went by the name of the 'tearer,' carefully covered over the bottom of a sort of tub with the required colour. A man dipped the block into the tub, and then pressed it hard and flat down upon the stretched cloth. Of course, the greatest care was needed to make the several impressions made by the block fit correctly into each other."

"That must have been exceedingly difficult to do," said Carrie.

"Yes. There were pins placed at the four corners of the block which made holes in the cloth, and thus served as a guide to the printer. You will easily perceive that it must take a great many applications of the block before a 'piece' of many yards could be covered. The blocks vary from nine to twelve inches in length, and from four to seven in breadth. Each colour or shade of colour will require a separate block. Now, suppose we have a design with three colours in it, a piece of calico twenty-eight yards long and thirty inches broad, and a block nine inches by five ; how many times must each of the three blocks be applied in order to cover the piece of calico?"

Pencils were busy for a few minutes, and then

Sydney and Carrie announced that each of the three blocks must be applied 672 times, making in all 2,016 applications.

"It must be very slow work to *print* a dress at that rate," said Arthur; but I dare say there is some quicker way of doing it now."

"You are right. Pieces of calico can now be printed by what is called 'the cylinder process,' a process which has made a wonderful alteration in the business of calico printing. You will easily believe this, when I tell you that by the cylinders a piece of cloth a mile in length can be printed with four colours in one hour, while it would take one hundred men and one hundred assistants to do it in the block method."

"Bravo!" cried Arthur. "But now, how is it done?"

"The cylinder, generally of copper, must first have the design engraved or indented in it; that is, not *raised* as in the wood blocks, but sunk or cut in *below* the surface, in the same way that the plates for engravings of pictures are done. This used to be done by hand; but as the cylinder must be as long as the *width* of a piece of calico, it was a very long and expensive business. It is now accomplished in this way:—A small soft steel cylinder, three inches long and one inch thick, has as much of the design as will exactly fit it engraved upon it, or cut *into* it. This is called 'the die.' The die is hardened, and made to transfer the pattern on it to another soft cylinder called 'the mill.' Now, I told you the pattern was

cut in upon the die ; how, then, will the pattern look upon the second small cylinder, the mill ? How does that leaf you like so much in one of our pudding moulds look upon the blanc-mange when it comes out of the mould ?”

“ I know,” replied Maggie. “ It stands up—it is *raised*.”

“ Just so, it is *in relief*, as we call it. So the pattern on ‘ the mill ’ will be——?”

“ In relief,” said Maggie.

“ True, ‘ the mill ’ is first hardened, and then by means of very great pressure made to *indent* its pattern upon the large cylinder as many times as it is necessary.”

“ What immense care it must take to make the pieces of the pattern join each other well and properly on the large cylinder,” said Carrie.

“ Indeed, it does ; this cylinder process, from beginning to end, is a wonderful example of what skill and ingenuity can effect.”

“ Well, mater, we have engraved the pattern on the large cylinder ; how is the pattern to be put or printed upon the calico ? that’s the next wonder,” said Sydney.

“ I think you will be able to understand the way without very much difficulty. We will suppose the cloth is going to be printed with only *one* colour. The engraved cylinder is firmly mounted between two other rollers, a large one and a small one. The small one is covered with woollen cloth, and revolves in a trough full of colour properly thickened. As it goes round, it

takes up a coating of colour, and spreads it all over the engraved cylinder. The piece of cloth hangs down *between* the engraved roller and a large iron cylinder covered with a blanket, and is well pressed against the engraved cylinder, and, of course, receives the colour from the cylinder."

"But, mamma," said Sydney, "please stop a minute. If the engraved cylinder is all covered over with colour, how will it give any particular pattern on the cloth—it will only make a *daub* of colour, will it?"

"You are perfectly right, Syd, and I hoped the difficulty would strike you. It is quite true that the cylinder, with the pattern on it, is covered all over with the colour, but all the colour upon the surface which is not wanted is removed by a very clever contrivance called 'the doctor.' This 'doctor' is a long, flat, smooth knife or blade, made to fit the roller most accurately, and when it is applied it removes every particle of colour from the *raised parts* of the cylinder, leaving it only on the *depressed* parts."

"'Doctor;' what a funny name," said Maggie.

"Yes, but not unsuitable, as it *cured* the evil. It is said that when the cylinder process was first being experimented upon, a workman was puzzled as to what could be done with the superfluous colour on the roller. One of the masters took up a common knife, and showed how it might be made to remove the colour. 'Ah, sir, you have *doctored* it,' exclaimed the man, and thus provided the instrument with its name.

"Now, as in block printing, so in cylinder, each

colour or shade of colour must have a separate cylinder. There may be two, three, four, or even as many as eight cylinders ; each cylinder will have its own trough of colour, its own small covered roller which applies the colour, and its own 'doctor' to remove the superfluous colour. The cloth will be made to press against each cylinder in succession, and the whole will be accomplished with the same regularity and exactness as if there were but one colour, and therefore but one cylinder."

"What clever brains some people must have, to find out *how to do* all these things. Who would have thought that a simple print dress would have cost all that lot of trouble !" said Arthur.

"And yet, Arthur, you can form but a faint idea from what I have told you, of the amount of thought, knowledge, skill and patience, which you will find are required and expended in the art of calico printing ;—whether you look into the laboratory, where substances are tested, methods investigated, principles applied, and experiments made ;—into the designing room, where the patterns are invented and the drawings executed ;—or into the dye houses and printing places where the different mechanical processes are constantly being carried on. It is no simple, straightforward work, one process answering for all sorts of colours, textures and patterns. So far from being *that*, almost every shade of colour, every kind of texture, every variety of pattern will require a different method of treatment. For instance, in some cases the cloth may be dipped in the

liquid *mordant*, and the colour or colours printed by the cylinder process on the different parts. In others, in what the printers call '*the madder style*' (*i.e.*, the method by which madder and most of the soluble animal and vegetable colours are applied), the *mordant*, properly thickened, is printed on particular parts by the cylinder; the cloth washed and passed through different mixtures in order to remove any of the mordant that can be dissolved out, and then dipped in the dye vat. Perhaps there may be as many as nineteen different operations in this method—perhaps even more. In another method, the cloth will be subjected to the action of steam from twenty to forty minutes *after* the mordant and the dye have both been applied. This not only causes the colour to adhere to the cloth very firmly, but makes it brilliant and delicate."

"How do they manage to leave the *white parts* in a pattern. I suppose they never dip the cloth wholly into the dye when there are white spots or places to be left?" inquired Carrie.

"Well, our dyers do not exactly follow the plan the natives of India are said to have adopted in order to keep the white spots on their *Bandana* handkerchiefs, viz., tie up the little spots with threads."

"I should think not," said Maggie, laughing.

"Sometimes the white parts are kept by being first printed with a kind of chemical mixture called a '*resist paste*,' which prevents the colour from fixing upon them. Sometimes, after the cloth has been wholly dipped in the mordant, the parts that are required to be *white* are

printed with some substance that acts as a '*discharger*, such as lemon juice, which expels the *mordant* from that part ; so that when the cloth is dipped in the dye the colour does not remain fast, and can be easily washed away.

Or, if the cloth has been dipped in the dye, the colour is driven away by the application of chlorine or chromic acid. The white spots on the Turkey-red handkerchiefs which we make in imitation of the Indian Bandanas, are thus produced. In addition, there are the after washings and *clearings* innumerable. Some pieces of printed calico may go through as many as thirty or forty different processes ; so many and so varied are the proceedings in that branch of the arts called 'calico printing.'

"Now, there are just a few 'HISTORY THREADS' about cotton manufacture, calico printing, and the art of dyeing, which I must put into your hands. I think I told you before, that for the extent and variety of her cotton manufactures, Great Britain carries away the palm from all other nations. From almost every part of the world the raw material is brought to her, which she takes, weaves it into good and serviceable textile fabrics, and then returns it back again to those very same countries."

"Well done, Great Britain !" exclaimed Arthur.

"I suppose that in this, as in everything else, we have greatly improved during the last few years ?" said Sydney.

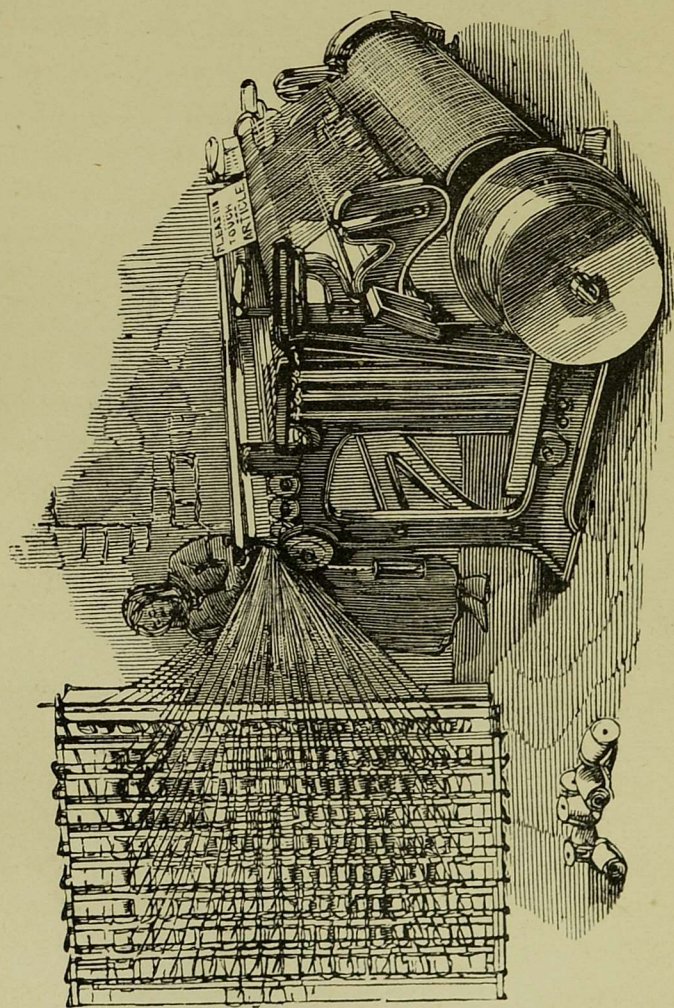
"Yes, especially in the art of dyeing ; for the [che-

mistry of the subject is now so much more studied and understood than it used to be. Many of our greatest men in science have given a large share of their thoughts to this most interesting of subjects.

"The discovery and application of the famous 'coal-tar' colours forms quite an era in the art of dyeing. These colours, the products of the distillation of coal.—(My dear Maggie, let your eyebrows down again; 'distillation,' the word that has apparently frightened you, simply means, a process by which substances are separated one from another by the means of heat, and one or more of the products condensed and collected.) I was going to say, these 'coal-tar' colours, are not only easy of application, but are as *powerful* as they are bright and beautiful, one grain will deeply tint half a gallon of water. Our great Faraday was the first to discover, in 1825, that a product called Benzol could be procured from coal tar. This Benzol is very useful in taking out grease from any material, because it easily dissolves fatty substances. From Benzol, or by means of it and nitric acid, can be produced the compound called 'Aniline,' which yields those splendid mauve and magenta colours."

"A piece of coal is a dark and unlikely looking cave for such bright things to come out of," said Carrie; "chemists must have magic wands."

"Another instance," said her mother, "of the glorious mysteries hidden away in this world of ours, that men may have the glad surprise of finding them."



WARPING AND BEAMING.

A great step was also gained in the art by the use of *mineral* compounds and the production of colour from the *double* decomposition and *double* affinities in the way I described, or rather hinted to you before. The cloth being dipped in two different solutions, chemical action takes place, and a new substance is formed and 'precipitated' or thrown down upon the cloth, and incorporated in the fibres. This new substance is 'insoluble,' *i.e.*, it cannot (easily) be dissolved and so washed away. Prussian-blue, chrome yellow, and manganese brown are some of these insoluble precipitates which can be thus obtained.

"Our calico printers laboured for a long time under some heavy and oppressive duties. It was not until 1831 that the duty of threepence on every square yard was repealed; and until nearly the end of the eighteenth century there was a law that prohibited the wearing of unmixed cotton—that is to say, the law only allowed that the *weft* thread should be *cotton*, the warp was obliged to be of *linen*."

"Why it could hardly be called *cotton* at all," said Carrie. "What was the law made for?"

"To protect the interests of the silk weavers. Whether it did so to any great and sufficient extent, I can hardly say, but it was certainly hard upon the cotton manufacturers and printers."

"That reminds me, mater, of what I wanted to ask you the other evening, and forgot to do so. Do you think it is wise, or foolish to make laws like that, for instance, to protect some one trade and discourage another?"

"I do not know enough about the subject, Syd, to make my opinion worth the having," replied his mother; "you must examine into the matter for yourself, by-and-bye. Take the history of any one of the different manufactures, and trace it out side by side with the history of the laws passed in reference to it, and find out the kind of effect that the one has had upon the other.

"I confess it has appeared to me, that, just in proportion as a manufacture, be it textile fabric or what not, has been *left alone*, neither favoured nor hindered by legal enactments, allowed to fight its own battles, find its own level; so have energy and industry, skill and invention, demand and supply in regard to that manufacture been excited or repressed."

"Thanks many, mater; I shall keep the end of that 'thread' and follow it out for myself, some day," said Sidney.

"Our future M.P., being coached by his mother;" remarked Carrie, *sotto voce* to Arthur. "N.B.—Subject of picture in the Royal Academy, by Caroline Norton;—date unknown!"

"Very good, Miss Carrie," said Sydney, who overheard the remark. "Paint away, and I will write the review of your picture, and see if I do not cut it up all to nothing."

"Let us take up our History Thread again," said Mrs. Norton, "I dare say you have all seen those brilliant red and blue handkerchiefs called 'Bandanas?' The blue ground is produced by a comparatively

simple process of dyeing with indigo. The *red* ground is the result of a most complicated series of operations. The madder root from which the colour is extracted, and the process by which the brilliant 'Turkey-red' dye is produced were known to the Hindoos long before the rest of the world. By degrees the knowledge spread into Asia Minor, and thence to Greece. About the middle of the eighteenth century some Greeks set up some dye works in Lauguedoc and Rouen; and towards the end of the century the knowledge reached us. A Frenchman set up one of these Turkey-red dye houses at Glasgow, and a few years after, another Frenchman established one in Manchester. The Glasgow works, I believe, still produce the largest share of this class of dyed goods. I can give you no idea of the number and variety of the processes through which a Turkey-red dyed piece of cloth will have to pass. The result, however, is worth the trouble, for the colour is one of the most durable of vegetable dyes.

"But that which caused the greatest improvement in the art of calico printing was the invention of the Cylinder-printing process."

"Who invented it? A *Frenchman*, of course?" said Arthur, in an uncomplimentary tone.

"The French certainly claim to have been the first in the field, but I believe we may dispute their right to do so, and award the honour to a Scotchman named Bell. There seems to be a tolerable amount of evidence to prove that Mr. Bell invented it in 1785, and

that it was in actual operation in Manchester, at least fifteen years before the French, by their own showing, knew anything about it in France. A M. Oberkampf has the honour of having introduced it into his *own country*. The process of engraving with the die and mill, which I explained to you, which was introduced about 1808, was a great boon to the manufacturer ; for by it an engraver could accomplish in a few days, what would have taken several months to do in the former way by hand. Before the invention of the cylinder process, you know, the printing was chiefly done by block. For a long time the designs were exceedingly simple, rather, I ought to say, *the* design, for the printers seems to have been limited to one ; and that merely a white spot printed with the ‘ resist paste ;’ after which the cloth was dyed. Now a Mr. Robert Peel, grandfather of the Sir Robert Peel who was Prime Minister of England, thought that he should like to have a *new* device ; so he invented a pattern formed from the parsley-leaf. At first he kept his idea a secret among his own family ; and in order that the printed calico with the new design should not go out of the house till all was completed, his daughters *ironed* it for him, as a substitute for the ‘ calendering’ process. It succeeded so well that it soon became known and went by the name of ‘ Peel’s Parsley.’ The name of Peel, I assure you, is a great name in the annals of calico printing.

“ Other names must also be remembered—that of the Ashtons of Hyde—who brought the power-loom

into operation at Stockport ; and the Claytons, who, I believe, in 1764, established the *first* works for calico printing set up in the Lancashire now so famous for them. It is said that the art had been practised in Scotland twenty-six years before it was introduced into Lancashire."

"Who first taught the English, mamma? for I suppose we could not manage to find out for ourselves," said Arthur.

"You are correct in your surmise, Pen, but do not be so wrathful. The art was first introduced into England by a Frenchman, who set up works near Richmond, about, some say, 1676, others, later. These were very soon followed by others at Bromley Hall, Essex. But there was but little done either of printing or manufacturing cotton goods till after the introduction of the spinning machinery. Previously to that, the small amount of cotton we required was all imported from Smyrna and Cyprus. You know how different it is with it at the present time.

"Now, let us go abroad. We shall find that they were in advance of us on the Continent, for at the close of the seventeenth century Augsburg was quite celebrated for its printed linens and cottons. Flanders was even a century earlier, and from thence the knowledge had spread into France and Germany. You remember, one of the many great events of the fifteenth century was the discovery of——?"

"The New World, in 1492," exclaimed Carrie and Maggie, simultaneously.

"Right. Now, in this New World, it was found that both cotton manufacture and calico printing were known and practised. Cortes sent home to his royal master, Charles V. of Germany, 'presents of mantles, tapistries, and carpets of cotton.' And from this new continent we also derived several new dyes—logwood, Brazil wood, and cochineal. The Spaniards profited by the knowledge they gained, so far as to set up manufactures of cotton in their own land. As to the new dyes, the Old World was long before it appreciated them. Logwood and indigo were anathematised, and their use strictly forbidden, both in Germany and England. The German Diet, in 1577, pronounced indigo to be a 'pernicious, deceitful dye;' and the Parliament of Queen Elizabeth denounced it as 'food for the devil!'"

"How absurd," said Sidney; "was it really an injurious dye?"

"Not in the least; but the introduction of it and of logwood interfered with the profits of the cultivators of native vegetable dyes, such as the woad plant, for instance, which yields a blue similar to indigo. The prohibition was not removed till the reign of Charles II.

"The Italians seem to have been the first to have recovered for Europe the lost art of dyeing; and they long enjoyed a monopoly of it. In the early part of the fourteenth century Florence appears to have had a large number of dyeing establishments. The very first book that, perhaps, ever appeared upon the art, was written by one John Ventura Rosetti, in 1548,

and is said to have greatly helped to excite the interest of French, English, and Germans, in this branch of manufacture."

"You say, 'recovered for Europe,' mamma; then Europe had possessed the art at one time?" said Sydney.

"Most certainly; but the invasion of the Northern barbarians put a stop for the time to the progress of the arts of peace. However, for several centuries it had been practised in Asia Minor and the Levant. Can you guess who brought the knowledge of the art to Western Asia?"

"The Saracens?" said Carrie, hesitatingly.

"Yes; they brought away with them from Eastern Asia the cotton plant, and the knowledge of the manufacture and the printing and dyeing of the material made from it. They established manufactures in Arabia and Asia Minor. It is said that the term *muslin* is derived from Mosul, in Mesopotamia; as *calico* is from Calicut, in the province of Malabar; and *nankeen*, from Nankin, in China.

"No one can say how long the art may have been known and practised in Eastern Asia. In the first and second centuries, A.D., the muslins of Bengal were celebrated. The Chinese are said to have used *blocks* for printing at a very early date. The natives of India seem to have traced their patterns with a reed or pencil. The large cotton chintz counterpanes, called 'pallampores,' manufactured in Madras, from time unknown, had wax applied with a pencil to those

parts which were not to receive the dye ; and dye-absorbing drugs laid on upon the other parts that were to be coloured, and the whole then dipped in the dye. Can you tell me, Carrie, the German for *cotton* ?”

Carrie looked in the dictionary and presently said, “Baumwolle. Why, mamma, that means ‘tree wool !’ ”

“Right, and that is the very term which Herodotus employs when speaking of the substance known and used by the natives of India. It does not seem that the cotton plant was cultivated in early times in Egypt, or the material made from it used by the Egyptians. There is no notice, as I mentioned before, of *cotton*, in the Bible ; yet the Jews were well acquainted with the art of dyeing linen and woollen material, and skins of animals. They could dye either *in the piece*, for instance, the ephod, or priest’s coat, which was all blue ; —or *single threads*, for embroidery ; and we read also of coloured ‘hangings’ for the tabernacle.”

“Yes, mamma, and Joseph’s ‘coat of many colours,’ ” said Maggie.

“Yes ; perhaps the coat was made of separate pieces coloured differently, and interwoven or sewn together by the needle. Variegated garments were not in common use. They were reserved for persons of distinction, such as the daughter of a king, or a victorious general. Perhaps that was the reason why the brothers were so jealous.”

“I suppose the Jews learnt about dyeing while they lived in Egypt ?” said Carrie.

“No doubt they did ; for the Egyptians were fami-

liar with several vegetable and earthy colouring substances for dyeing purposes; also with some few mineral ones; though the latter were used more for *painting* than dyeing. Some of the mummy cloths are embroidered with coloured threads, linen threads dyed in the yarn; others have painted borders on them. But the nation of dyers and of dyes *par excellence*, in ancient times, was the Phœnician. Tyre, the 'proud city by the sea,' gained no small amount of her fame and her riches by her renowned 'Tyrian purple.'"

"Where did they get it from? and how did they make it?" asked Arthur.

"It was procured from two species of shell-fish (mollusca). The *buccinum*, which was found chiefly in cliffs and rocks; and the *purpura*, found by fishing in the sea. These fish were procured from the coasts of Sicily, the Peloponnesus, and the coast of Britain."


"Fancy sailing so far in those days; why, Britain must have seemed an awful way from Tyre," said Arthur.

"True, but the Phœnicians were the most enterprising of people, and, at least in the interests of commerce, thought no risks too great to be run. A single drop only of the dye could be procured from each fish, which single drop was contained in a small vessel in the throat. This was at first colourless, but by exposure to light and heat became of different hues. I ought to warn you that the term 'purple' covers a great variety of tints, from scarlet to the rich, deep, blood

red of royalty. I have read that our British mollusc the common dog-whelk, will yield a colour similar to this ancient dye. But no doubt the variety of tints, and the extreme brilliancy of some, were produced by artificial means, the secret of which the Tyrians carefully guarded in their own hands. It is supposed they *always* dyed the wool first, and sometimes the *yarn* afterwards; at least in those colours that were called 'double-dyed.' Whatever means they used, they long enjoyed a proud pre-eminence in the art of dyeing, and their famed purple long continued to be the colour sacred to the gods, and to their vicegerents, the kings.

"And now I have reached the end of all the 'Threads' that I wish to unravel for you to-night from that commonplace thing—*A Print Dress*."

A KID GLOVE.

“ HERE lies my gage,” said Mrs. Norton to the assembled group at their next meeting, throwing down upon the table a white kid glove. “Who will lift my glove?”

“Do not touch it, Maggie,” said Sydney, as Maggie was about to take it up; “you don’t know to what terrible thing you may be pledging yourself. Don’t you know it is a challenge to *mortal combat*? Leave that to Pendragon, it is more in his way. Pray with whom may be your quarrel, mamma?”

“Well,” replied Mrs. Norton, “my feelings are certainly not quite so warlike as my words would imply; but I challenge, or rather I should say I invite, any one of the present company to take up that glove, and to tell us what the particular substance is, from which it is made.”

“That cannot be so very difficult,” said Carrie, taking up the glove. “We all know it is made of leather.”

"Very good. Please to tell us what you mean by *leather*?"

"Leather! Leather is—why, it is the skin of an animal, and this kid glove is the skin of a kid," continued Carrie, somewhat quickly.

"But parchment is made from the skins of animals, yet it is not, strictly speaking, 'leather.' So I must still press my question a little further. You are right if you say it is made *from* the skins of animals; but you must please to tell us *from what part* of the skin, and what the substance called *leather* really is?"

"From what *part* of the skin?" repeated Carrie, looking puzzled. "I do not quite know what you mean, mamma."

"You had better have left the glove alone, Carrie," said Sydney. "It's no that canny, I'm thinking. Lay it down again. The mater must please to take up her own gage her ain sel'. She must teach, and we will learn."

"Come, that's a fair challenge to you, mamma," said Arthur.

"And I accept it," said Mrs. Norton, taking up the glove which Carrie had laid down. "Carrie was almost right as far as she went, but we must go a little further. The skin of an animal consists of two distinct parts. There is the part called the *cuticle*, or *epidermis*, on which the hair or wool grows. Then there is the part next to the flesh, which is called the *corium*, *cutis*, or *dermis*. You must remember all these names, because it is sometimes spoken of by one and sometimes

by the other. This latter part is a dense, hard membrane, composed of numberless fibres which interlace each other in all directions in a most complex manner, and these fibres are more closely *woven* on the upper side, then on the under or flesh side. Now, it is *only* of this 'true skin,' as it is termed, that leather can be made——"

"We have still to do with a *woven material*, it seems," said Carrie.

"Yes, but the *weaving* has been done for us by Nature," said Sydney.

"Then it is this 'true,' this underneath skin, that is really *leather*, I suppose?" said Maggie.

"Not so fast, Maggie. This 'true skin,' *corium*, is not yet '*leather*;' it is only the material from which leather can be produced."

"Oh, I see, it must have a lot of things done to it before we may call it *leather*," said Arthur.

"Not only so, but the substance itself must be changed—in fact, a new substance must be produced. This fibrous membrane has the power of chemically uniting with certain other substances, and of forming with one or other of them a new compound possessing fresh and peculiar properties."

"Then that *new* compound is what we call 'leather,' I suppose," said Sydney; "but what are the things with which the skin will unite, and so become changed?"

"There are several—tannin, or tannic acid, salts of alumina and some fatty substances; but *tannic acid* is by far the most frequently employed; and this has

given the name to the process by which the skin is converted into leather."

"What is this tannic acid, or tannin?" asked Carrie.

"It is a substance that exists very largely in the vegetable kingdom; it is found in gall-nuts, in the bark of nearly all perennial trees, in the leaves of the strawberry, and of some varieties of the oak, in the capsule of the unripe fruit of the walnut and the horse-chestnut, and in the pulp of the fruit of the pomegranate; in fact, in so many varieties of vegetable substances, that I cannot mention half their names. The tannin procured from the bark of the oak is extensively used, and is preferred above that which is obtained from other sources—at least in the tanneries of Great Britain and Ireland."

"Well, now, mamma, let us set to work at once and make the leather," said Arthur, in his usual impetuous style.

"The manufacturer awaits your orders, Sir Arthur. As it is a kid glove which forms the basis of our conversation, I propose that we first turn the skin suitable for *gloves* into the substance called leather; for the lighter kinds of thin leather are manufactured by a process similar yet different to the one employed with the skins or hides that form the thick, heavy kinds of leather. But whatever may be the purpose for which the made leather is required, the preliminary and very important series of operations is similar in each, and is undertaken for the purposes of thoroughly *cleansing* the

skins, and for separating the *corium*, or true skin, from the *epidermis* and the hair. The epidermis will not unite as the *true* skin will do, and therefore no leather can be made from it; and it is of great importance that it should be most completely separated from the other part.

“The skins are soaked, and steeped, and washed in water many times, and then placed in pits of lime and water, or subjected to the action of some process that shall have the same effect, which is to soften and dissolve the cellular matter that binds the hair and the epidermis to the *cutis*, or ‘true skin.’ When this is accomplished, the hair and the outer skin are carefully stripped and scraped off with a peculiar kind of knife called the ‘unhairing knife.’ After all the hair and epidermis have been removed, the skins go through a process termed ‘*bating*.’ They are soaked and steeped in different mixtures to get rid of all the lime, for if any of it remained it would injure the leather.

“Now that the fibrous membrane has been thus prepared, it is ready to be turned into leather. As this is the skin of a kid that we are supposed to be going to change into leather, it must not be tanned; that is, it must not be made to unite chemically with *tannic acid*. It must be what the manufacturers call ‘*tawed*,’ that is, it must be made to unite with a compound of alumina. A solution of alum and salt is put into a cylinder, the skins placed in it and well stirred about, and in time the membrane becomes

incorporated with the alumina. The skins are taken out of the bath, and most carefully dried. If they are to remain *white*, they are next placed in a bath of wheaten flour and yolk of eggs; a mixture which enters into the pores of the membrane, and makes it soft and supple. If the skins are to be coloured, the colouring matter must be applied upon the *grain*, or hair side, while they are moist, and well rubbed in. The skins, or, more correctly, the pieces of leather, are then stretched and softened by means of the 'softening iron,' a process which gives them their elasticity; polished by rubbing with pumice stone, and in some cases smoothed with a flat iron. And now the thin, soft, smooth, elastic leather, white or coloured, is ready to go to the glovers."

"But, mamma, all leather is not nearly as soft and elastic as this kid glove; my boots, for instance. How is that kind of leather made?" asked Arthur.

"The leather of which your boots have been made—and all heavy leather, such as is used for harness, saddles, &c.—goes through another kind of process. After the 'true skin' has been cleaned and thoroughly separated from the hair and *cuticle*, in which state it is called 'pelt,' it is sent to the tan-yard to be 'tanned;' that is——?"

"Made to unite with 'tannin,' procured from the bark of the oak," replied Carrie. "But how?"

"I must not enter into all the details of the process; but the general facts are these:—A tan-yard consists of a number of oblong pits about six or eight feet deep;

into these pits the skins and the tannin are laid. The old plan used to be, to lay powdered bark in the pits, then a layer of hides, then more bark, then another layer of hides, and so on alternately till the pit was full, when all was pressed well down and covered over, so that neither air nor moisture could penetrate. But this plan, though good leather was produced by it, was exceedingly tedious, for it occupied several months, and in some cases even one or two years. Many new ways have been tried to expedite the process, though not always with good results. The plan now generally adopted is to let a *solution of tannin* flow by means of pipes into the pits. This solution, or 'ooze,' as it is called, is of different degrees of strength in the different pits, and the skins are removed gradually from the weak solutions to the strong ones. The object of all the different methods that may be employed in the process of 'tanning' is to make the tannic acid thoroughly permeate; that is, *go into* the fibres, and become incorporated with the membrane."

"I suppose it is almost done now," said Maggie.

"No," replied her mother; "you travel rather too fast. After the 'tanning,' the leather has to go through a number of different processes. If it is to be made into soles for shoes, or anything that requires to be very dense, it will be well beaten with hammers in order to compress the fibres. This 'beating' was formerly done by hand, but is now accomplished by machinery. But if it does not need to be so very

dense and compact, the heavy 'beating' will be dispensed with, and it will pass through a set of operations that go by the general name of 'currying.' The leather will be soaked, stretched, oiled, waxed, dyed, pommelled; and polished. These several operations vary according to the use to which the leather is afterwards to be applied. The result of them is to make it smooth on the surface, equal in texture, soft, pliant, elastic, more or less dense, and granular in appearance. This last effect, the 'bringing up the grain,' as it is termed, is produced by the 'pommeling' process, in which the leather is rubbed by a piece of hard grooved wood called 'the pommel.' Now, perhaps you may be able to form some slight notion of the number and variety of the processes through which the skin of an animal has to pass before it becomes LEATHER; and that leather can be made fit to be used for our gloves, shoes, harness, book-covers, or any other article formed of that substance."

"It seems to me," said Arthur, "that there is nothing easy and simple in this world. Everything takes so much time and trouble."

"Very true, Pen," replied his mother. "I have never yet found the thing that was easy and simple in your sense of the words. But there is one little matter about which I should like to feel sure that you younger ones are clear in your own minds. It is just one of those simple things which grown-up people are so apt to take for granted that they know and every one else knows; and because they are taken for granted, many

people grow up without knowing them with any degree of exactness. You know that the skins of kids and goats furnish the leather from which most *gloves* are made ; but the leather made up into other articles is produced from the skins of other animals. Maggie, can you give us the name of the animal whose skin has furnished the leather for the tops of your shoes and boots? And you, Arthur, tell us the one whose skin has done the same for the *soles* of your boots."

"I never thought about it, mamma, I put everything down as *leather*, and there was an end of it," replied Arthur quickly.

"I am quite sure I don't know, mamma, so please tell us about all different leather things," said Maggie, coaxingly. The two elder children kept a discreet silence.

"It is just as well to know," replied Mrs. Norton. "The leather for the *soles* of boots and shoes, harness, saddlery, leather-trunks, hose for fire-engines, and gloves for cavalry is made from *ox*-hides. The skin of *calves* furnishes the leather for the *upper* part of shoes and for the covers of books."

"From *sheep*-skins, is made the leather that does for the covers of common books, the lining of carriages, under-waistcoats, whip-lashes, aprons, and things that require a cheap thin leather. *Lamb*-skins and the skins of kids and goats produce the leather for gloves and ladies' shoes. The young lambs of the Spanish merinos are valuable for this purpose. The best *kid*-skins come from Switzerland and Tuscany ;

the *goats*, from the coast of Barbary and the Cape of Good Hope. *Horse* hides furnish collars and some other parts of harness. Enamelled horse-hide split and shaved thin is used in imitation of seal-skin for ladies' shoes. *Dog*-skin makes a thin, tough, good leather for gloves ; and *deer*-skin furnishes—?”

“ Oh, please let me say that, for I know that it makes clothes for the Laplanders,” exclaimed Maggie.

Yes,” said Carrie, “and for the Kamchadals also ; we read about their dress, you know, mamma, in that book called, ‘Reindeer, Dogs, and Snowshoes.’”

“ True ; and at one time, our reindeer-skins, ‘shamoyed,’ *i.e.*, dressed with oil, were extensively used for soldiers' breeches ; and our manufacture of it was considered to be so excellent that both Prussia and Austria came to us for supplies. This sort of leather, however, was discouraged for that purpose after the Peninsular war, because it was found to retain moisture so long ; and woollen cloth was used instead. I dare say you have often met with the expression ‘Buff-jerkin?’ Carrie and Syd must have done so in some of Walter Scott's tales. What meaning did you attach to it ?”

Carrie and Syd looked at each other for a moment or two ; at last Carrie answered, “ I thought ‘jerkin’ meant a jacket of some kind, and ‘buff’—well, I suppose I thought it referred to the *colour* of the jacket.”

“ Yes, you *supposed* you knew, and so took no more trouble about it. The great evil with many people,

is the '*supposing*' that they know, and therefore letting the matter alone. It is far better to *know* that you are ignorant than to 'suppose' you are wise. In the first case you stand a chance of getting improved ; in the other there is no hope. You are by no means alone, my dear child, it is the besetting vice of most of us. But in this particular instance, I can easily help you out of your ignorance. A 'Buff-jerkin' means a *leathern* jacket. At one time there was a kind of *leathern armour* worn instead of metallic ; and this leather was procured from the hide of the wild bull of the forests of Poland, Hungary, and some parts of Russia. This animal went by the name of the '*buffe*.' Now you see the origin of our term 'buff-leather.' Our present so-called 'buff-leather' is made from the hide of the cow, and is used chiefly for soldiers' belts."

"I cannot fancy armour made of *leather* could be of much use," said Arthur.

"Real good 'buff-leather' is said to be pistol proof, and is very tough and pliant. In the wars of the time of Charles I. you will find it was greatly used."

"Mamma," said Syd, "I believe I was as ignorant as Carrie as to the meaning of 'buff-leather ;' but I was not quite so ready to own it, I fear."

"Better late than never, my boy," said his mother.

"You said the deer-skins were 'shamoyed.' I thought chamois leather was from the chamois goat," said Carrie.

"The process of dressing leather in oil was first applied to the skin of that animal, and hence the

term, 'shamoyed' came to be used to all skins so prepared."

"What makes Russian leather so valuable, or at least to be thought so much about?" asked Syd.

"It is valuable because it is not easily affected by moisture, nor liable to be attacked by insects. The peculiar smell which it has is produced from an essential *oil of birch* which is laid on to the skin while it is moist, after tanning. In Russia all kinds of skin are used ; but elsewhere only the skins of sheep and goats."

"What is 'morocco' leather, mamma?" said Carrie.

"Real morocco is made from goat-skins tanned with sumach (a shrub that grows in the United States, in Asia, and the south of Europe), and then dyed on the grain or hair side. You have noticed, perhaps, the ribbed appearance of morocco. This is produced by grooved rollers passed carefully several times over the leather. An imitation kind of morocco is made from sheep-skins."

"Did you say that parchment is *not* leather ; yet it's made from skins, is it not?" said Sydney.

"The skins are cleansed and separated from the hair and epidermis, but they are not 'tanned' or 'tawed.' They are well stretched and scraped, and rubbed with pumice stone (operations performed several times), till the skin is made soft, and smooth, and even ; but as the fibrous membrane has not been made to combine with tannin, or with substances that take the place of tannin, and produce similar action upon the fibres, parchment is not called *true leather*. It is the same with an article termed 'shagreen,' which is made in

much the same way from a strip of skin along the back of the neck of the camel, ass, and horse. We were indebted to the East for the knowledge of the manufacture of both these materials ; and the Kirghis women of Central Asia are remarkable, at the present time, for their manufacture of shagreen.

“There are not so many HISTORY THREADS connected with this subject, as there are with those we have already discussed ; and the few that I can give you, I am afraid you will think somewhat grey and dull in colour.”

“Never mind, mamma ; draw them out, please. I have no doubt they will lead us into some pleasant by-path meadow.”

“Oh, but then, perhaps, we shall meet Giant Despair, and be shut up in Doubting Castle,” said Maggie, who had lately taken up with “The Pilgrim’s Progress.”

“Ah, that’s a warning to all children to walk steadily along the proper road, and not to try and clamber over gates, and scramble through hedges ; as a young lady of my acquaintance has been known to do. Don’t you think it is, mamma ?” asked Sydney, with the utmost gravity.

“Maggie is at liberty to accept your interpretation of that part of the allegory, if she so please. Whether that is exactly the moral which Bunyan intended should be drawn, is quite another question. But let us draw out our ‘Threads.’

“Our own leather manufacture, according to the ‘Report of the Jurors’ for the Exhibition of 1862,

seems to have greatly improved and extended since the repeal, in 1830, of all duties upon leather. It used to be somewhat of a monopoly, and confined to few localities. Bermondsey was, at one time, the principal seat of the manufacture ; but now tanneries are to be found in the outskirts of almost all large towns where the water supply is abundant. *Plenty* of good water is essential, as you can well conceive, to the tanning operations. England, it is considered, produces more leather for purposes suited to the great mass of the people, than any other country. It was calculated, in 1851, that 350,000 persons were employed directly in the leather trade ; and now we may be sure the number is much greater."

"Every one in England wears boots and shoes, so there must be plenty to do to make them," said Maggie. "It must be *miserable* to go without."

"Well, every one, however poor, likes to *possess* a pair to wear upon holidays ; but there are a good many of our town and country Arabs who make themselves exceedingly content without that, what we should call, absolute *necessity*, but which to some of them is a *painful luxury* ; a pair of boots."

"Surely, mamma, it must be much more *painful* to walk without shoes, than with them," said Carrie.

"I cannot speak from experience," replied her mother ; "but I have heard that the feet, when thoroughly unaccustomed to wear any defence, become far harder than any leather can possibly be ; and that after enjoying entire freedom, the feet will suffer con-

siderably from the pressure and confinement of boots. I have seen some of our young Lancashire Arabs, who had paid their homage to the requirements of civilisation, and worn with pride and pleasure their 'new boots' to go to the Sunday-school, sit down under the hedge the moment they had parted from their companions, and deliberately take off their boots, tuck them under their arms, and go on their way singing; the rain meanwhile pouring down in torrents. Two good things were thus secured; the new boots were kept from the wet, and the feet were once more at ease.

"Boots will last a long time if dealt with in this way. In the family of a Maltese peasant, I have read, that a pair of boots will serve their purpose for many generations."

"What a saving of expense it would be to you, mamma, if our boys could make their boots last in that manner," said Carrie.

"True, but to do that, they must, like the Maltese peasant, *carry them in their hands, even* on holidays."

"Just as Pen does with his gloves on Sundays," said Syd. "I make a point of saving for him such of my old pairs as are decentest. Scrunched up in the hand as he scrunches them, they do just as well as new ones. I think you should pay me something, mater, for keeping Pen in gloves."

"And getting new ones for yourself a little earlier, on that pretext, I suspect; oh, most benevolent of brothers. You wear very nearly as many pairs as I do

in a year," said Carrie, laughing. "But never mind," she continued, "it is very good for trade, and for poor women. The making of gloves gives employment to women, does it not, mamma?"

"Yes; the sewing of them up gives work to numbers of women in the neighbourhood of those towns where the manufacture is carried on—London, Worcester, Yeovil, Melbourne Port. But in the wearing of your gloves, I shall be quite content if your ladyship will restrict your benevolent feelings to the consideration of the state of *my purse*, and moderate your partiality for 'best French kids.'"

"Why is it, mamma, that *French* kid gloves are thought to be so superior to English ones?" asked Maggie.

"I can hardly tell you, Maggie. The greater purity of the air in France may have something, perhaps, to do with it, as some of the processes are, I believe, considerably affected by the state of the atmosphere. Whatever may be the cause, France is certainly superior to us in the production of all the lighter kinds of leather. But our English tanners are not far behind, and in the preparation of enamelled seal-skins, England is before other nations."

"France is always the first in light frippery kinds of things, such as gloves. I don't suppose she can make such good, useful boots and shoes as we can," said Arthur.

"There you are mistaken and unjust, Pen, for in the Exhibition of 1862 France was especially com-

mended, not only for her excellent *light* leathers, but also for her productions in the solid, heavy kinds. And this was greatly to her praise, because it must be owned our English tanners have great advantages in the native excellence of our oak-bark, and the fine quality of our British ox-hides. Germany, also, was highly praised for all her varnished skins ; Russia, for the long boots made of her peculiar leather, and for the magnificent workmanship of her reindeer-skins."

"Suggest to uncle that he should bring with him some of these famous skins when he comes home next year, will you, mamma?" said Carrie. "They would be delightful for the phæton, I'm thinking."

"I hope your uncle may appreciate the suggestion, Miss Carrie," replied her mother. "But I was going to say, that I think you would have been amused and interested at some of the leather-cutting machines exhibited in 1862. There was one that could cut sixty soles, of any width, in one minute of time. Another could *split* the skins with great rapidity by pressing them against a revolving grindstone.

"Now, greatly as our Pendragon dislikes *kid* gloves, I suppose he would not object to knightly *gauntlets*?"

"Ah! that's quite another thing," said Arthur. "They are made of *iron*; something fit for men to wear."

"Yes; in comparatively modern days they were, but not always. The gauntlets of Edward the Black Prince were of brass, and the knobs upon the knuckles, called 'gads,' or 'gadlings,' were in the form

of lions or leopards. It is in that century, I believe, that we find that the *leathern* gauntlets were first furnished with overlapping plates of iron on the backs, and the knuckles armed with knobs or spikes of iron. Most formidable weapons they must have been when the combatants fought in 'close lists,' as it was termed. But what will you say, you professed despiser of all luxury, when I tell you that the tops of these gauntlets, from the wrists, though made of steel, were *lined with velvet?*"

"Velvet!" exclaimed Carrie. "Why, I should have thought men, especially *warriors*, could have done with something less soft and delicate than velvet, if they needed linings at all."

"Luxury finds its patrons everywhere, Carrie, even among 'men of might.' Witness the richly jewelled armour of the fifteenth century, to say nothing of the hanging sleeves of silk, or even richer material, that we find were worn over the armour in the reign of Henry V."

"When did ladies first begin to wear gloves?" said Maggie. "I wish it was not the custom to do so now, for I am always losing mine."

"I believe that gloves were not worn by ladies or gentlemen till the eleventh century, at least in England. There must have been glovers in Germany, however, before that time; for in the reign of Ethelred II. we read that 'five pairs of gloves made a considerable part of the duty paid to that king by some German merchants who were anxious to have their trade pro-

tected.' Gloves soon became very fashionable among the nobility, who had them both embroidered and jewelled. In Queen Elizabeth's time we read of 'sweet washed' gloves; that is, gloves that were perfumed. One wonders that people were not afraid to wear gloves, especially perfumed ones, considering the vile purpose for which they were sometimes employed in the sixteenth century. The art of poisoning was brought to such perfection in those days, that a pair of embroidered gloves, looking fair and beautiful and fit for ladies' hands, might be so thoroughly impregnated with such deadly poison, that soon after the luckless and unconscious victim had drawn them on, life would become extinct."

"How horrible!" said Maggie.

"And what a cowardly way of killing your enemy!" said Arthur.

"Yes, indeed. What would our friend Simon Glover, the much respected burgher and merchant of the fair town of Perth, have thought if he had heard of such a use being made of a pair of gloves? You remember, perhaps, how he maintains that *a glove* was always an emblem of honour. When carried on a spear point, it was a pledge of faith and friendship; when thrown down, a gage of combat and defiance; but nothing cowardly or dishonourable was ever associated with *a glove*. And he further contends that his craft was far more honourable and ancient than that of the 'shoemakers,' even though they had a St. Crispin as their patron saint."

"Who was St. Crispin, mamma, and what had he to do with shoemakers?" asked Arthur.

"St. Crispin was a native of Rome, who lived in the fourth century. He and his brother went to France to try and convert the people to Christianity; and to support themselves while there, they worked as shoemakers. He suffered martyrdom, and the shoemakers have adopted him as their patron saint. I do not know whether you took the trouble to read the '*note*' in Sir Walter's novel of '*The Fair Maid of Perth*,' about '*the Glovers of Perth*?" inquired Mrs. Norton, looking at Carrie and Sydney.

"I am afraid not, mater, speaking for '*self and partner*,'" said Sydney, with a penitent air. "But if you will tell us this once, we will do better next time."

"It is more than you deserve," replied Mrs. Norton, smiling. "But we gather from that note that the glovers of Perth were a wealthy and respected community, owning lands and making grants of lands and monies for religious purposes. They seem also to have been ready enough to fight when occasion required, and occasions were plentiful in those days. In the wars and troubles of the seventeenth century, the Corporation is said to have borne their share. Among their archives there is a banner with this inscription:—'*The perfect honour of a craft, or beauty of a trade, is not in wealth, but in moral worth, whereby virtue gains renown;*' surmounted with the words, '*Grace and peace.*'"

"Well done, '*glovers of Perth*,'" exclaimed Arthur.

I do like men that can fight as well as work. I do not fancy you would find tradesmen of these days—glovers or any others—that would be half such jolly fellows.”

“Nor I either,” said Carrie. “Mamma, this reminds me of something I have been wanting to ask you for a long time. *Why* is it that ages that are past seem as if they must have been so much nicer in most ways, than our present times are?”

“Mention some of the things that appear to you to have been better in past days than they are now,” replied her mother.

“Well, the men were braver and more manly, and the ladies were——Oh, I do not know how to put it. Help me, please, mamma, for I am sure you know what I mean.”

“Perhaps I may ; but you must really learn to clothe your own thoughts in your own words ; for, as you know, the not being able to do so is one of the many deficiencies of which the Examiners for the Oxford Local Examinations complain in their last report. You have begun tolerably ; try again.”

“Well,” said Carrie, making a desperate effort to clear her throat, “ladies in past times were thought *more of*; *their* approval seemed to make the men braver and more noble. I suppose they were more beautiful then than we are now ;” and Carrie heaved a small sigh. It was impossible to avoid a hearty laugh at the expression of plaintive sorrow and resignation on the girl’s face.

"Bravo! Carrie," exclaimed Arthur. "I dare say that *was* the reason. But, mamma, I think just the same as Carrie. I think those old days—when those old Perth glovers lived, for instance—were an awful lot better than ours. Don't you really think so, mamma?"

"What has Syd to say on the matter?" said Mrs. Norton.

"Well, mamma, Carrie and I have often talked about it when she has been reading Walter Scott to me, and we never can quite agree. Books like his, and even some parts of regular history books, do make one feel as if there was more of bravery, and courage, and knighthood, and chivalry—more to excite and interest—in olden days than there is now. Yet I know men were often rough and brutal enough, even to their lady-loves," said Sydney.

"Oh, I am sure they were," exclaimed Maggie. "Even some of Arthur's pet knights—that man that papa was reading about the other night—the one that had that timid little wife, who was so afraid of him, and yet loved him so very much;—fancy papa ever speaking so to mamma!—ordering her what dress she should wear! Who was he, mamma, I forget his name?"

"You mean Enid and Geraint, I suppose, Maggie."

"Oh! Enid was a silly little thing, and Geraint was a horrid old bear," said Arthur, with some warmth; "they are not specimens of *my* kind of heroes."

"But, mater, how is it," continued Sydney, "why

have we this impression? We must get it from books and writers; surely they cannot all be false."

"I do not know that I can answer your questions better," replied Mrs. Norton, "than by telling you, as well as I can remember, of some remarks that I once heard, many years ago, from the late beloved Frederick Denison Maurice.

"I went to hear him give a reading from Spenser's 'Fairy Queen.' Spenser, as you know, lived in the days of Queen Elizabeth. Before he began the poem itself, he made a few remarks in reference to this very feeling of admiration for past times which you have been expressing. He said we were all accustomed to speak with more or less enthusiasm of the 'glorious times,' the grand days of 'Good Queen Bess,' and to feel as if our own age was really tame, and insignificant, and poor, and evil, in comparison."

"Yes, that's exactly what we think," said the children simultaneously.

"The lecturer then begged permission to read a passage from a noted writer who lived in those very times. I am sorry that I cannot, at this distance of time, be so sufficiently certain of the name of the writer as to venture to give it to you. But it was some one who thought and felt deeply, who lived in the very midst of the things he described, and had ample opportunities of noticing what went on around him. And then he read us a most mournful lament over the evil, and sin, and misery, and *littleness* of those very times.

“Now, surely,” said Mr. Maurice (I cannot, of course, give you his exact words), ‘we must have derived a wholly false impression of those days; and the writers from whom we have gained it must themselves have been greatly deceived—not so, of necessity. Both the pictures, dissimilar as they are, have truth in them. A serious, reflecting, feeling man, writing of the actual times in which he was himself living, would, most assuredly, be far more alive to the evil than to the good that was around him; for the sin and the misery would be as a cloud of dust in his eyes, blinding him to all besides. The evil of a particular age,’ continued the lecturer, and the words, and the face, and the voice, have stayed with me ever since, ‘is as the chaff upon the threshing floor, which the winds of heaven blow away; the *good* belonging to that age is the grain which Time carefully garners for the use of his children in after years.’ And then followed the few, short, quiet, telling words, such as he so well could give, which made young and old alike feel that each one was daily adding something either to the chaff, or to the grain.

“So, you see, that those things which you admire, and rightly—the chivalry and the bravery of past days—constitute the *grain* which really belonged to them; though had we been living then, and inclined to reflect, the coarseness, brutality, oppression, and evils of many kinds which, as really, formed part of them, would, no doubt, have been the things we should have noticed the most.”

"Thanks, mater, very much. I think that explains a great deal," said Sydney, thoughtfully.

"Now, let us take up the few remaining 'HISTORY THREADS,' and unwind them a very little further," resumed Mrs. Norton. "You seemed surprised, Arthur, when I mentioned, a little while ago, that *leather* was used as armour; but I do not think you would, if you had thought for a moment or two. Harold II. ordered his soldiers to wear leathern armour *only*, because it was much lighter than what the Saxons had been in the habit of wearing. It was to be made with overlapping flaps, and these flaps were 'to be stained of different colours, and formed into the shape of leaves or scales.'"

"That would make them look fierce, at any rate," said Maggie.

"Yes; it reminds me of what the Sarmatians are said to have done (the tribes who inhabited the vast tracks in the south of Russia); they collected the hoofs of horses—purified them, cut them into pieces, and polished the pieces so as to resemble the scales of a dragon—and these they sewed together with the sinews of horses and oxen. A Greek writer tells us 'that this body armour was not inferior to that of the Greeks in elegance and strength.'

"Now, will one of you tell us of what the shields carried by some of your favourite Grecian and Trojan heroes were made?"

"Oh, the shield of Achilles was made of metal," said

Carrie. "I remember that beautiful description of it which you read to us, mamma—not so long ago. It was a translation from some French writer, was it not? But Achilles is by no means a favourite of mine—I think he was selfish and sulky."

"Never mind the character of the great man just now, Carrie. All I want you to understand at this present time is, that a great number of the ancient shields were made wholly of bull's hide, twice or three, or even more times, folded.

"Then I suppose the Greeks, and of course the Romans, knew how to manufacture leather?" said Sydney.

"They either knew themselves, or they employed people who did. The Romans, it is thought, made use of leather before they knew how to manufacture it. Skins prepared by alum must have been considered valuable by them, for I have read that none but those who had served as Ediles were allowed to wear 'red shoes dressed with alum.' Roman senators wore *black* shoes, with an ornament of gold and silver on the top. Gaily coloured shoes were permitted only to women by one of their emperors; while another forbade women to wear gold and precious stones in their shoes. Almost all nations, from the very earliest times, seem to have adopted some means or other by which to render skins of animals durable and fit for use; though very little, if anything, is known of the methods they employed.

"I should think the North American Indians must

have known ; or else, how could they make their mocassins and their mittens, and——”

“But then, those were ‘*magic mittens*,’” replied Arthur. “I should like to have such a pair, if I knew how to manage them.”

“Well, but if they were ‘*magic mittens*,’ they were made of deerskin !” retorted Maggie ; “and besides, Old Nokomis ‘made a cloak for Hiawatha,’ from the hide of the red deer. How do you suppose she managed it, mamma ?”

“Indeed, Maggie, I cannot say. Perhaps in some such way as the savage tribes of South America are said to do. They dry, and stretch, and steep, and scrape the skins from the various animals ; and then place them in an earthen pot, together with the ‘powdered brains’ of the animals, and beat up the mixture. The fatty and other substances which this *brain powder* contains, produce on the skins a kind of *lather* which renders the skins clean and pliable.”

“*Powdered brains* ! What a mysterious, witch-like compound,” said Sydney.

“Witch-like or not,” replied Mrs. Norton, “modern science appears to have found out that this very substance, ‘animal brains reduced to pulp,’ answers better for the dressing of chamois, kid, and other light leathers, than the yolk of eggs, commonly employed.”

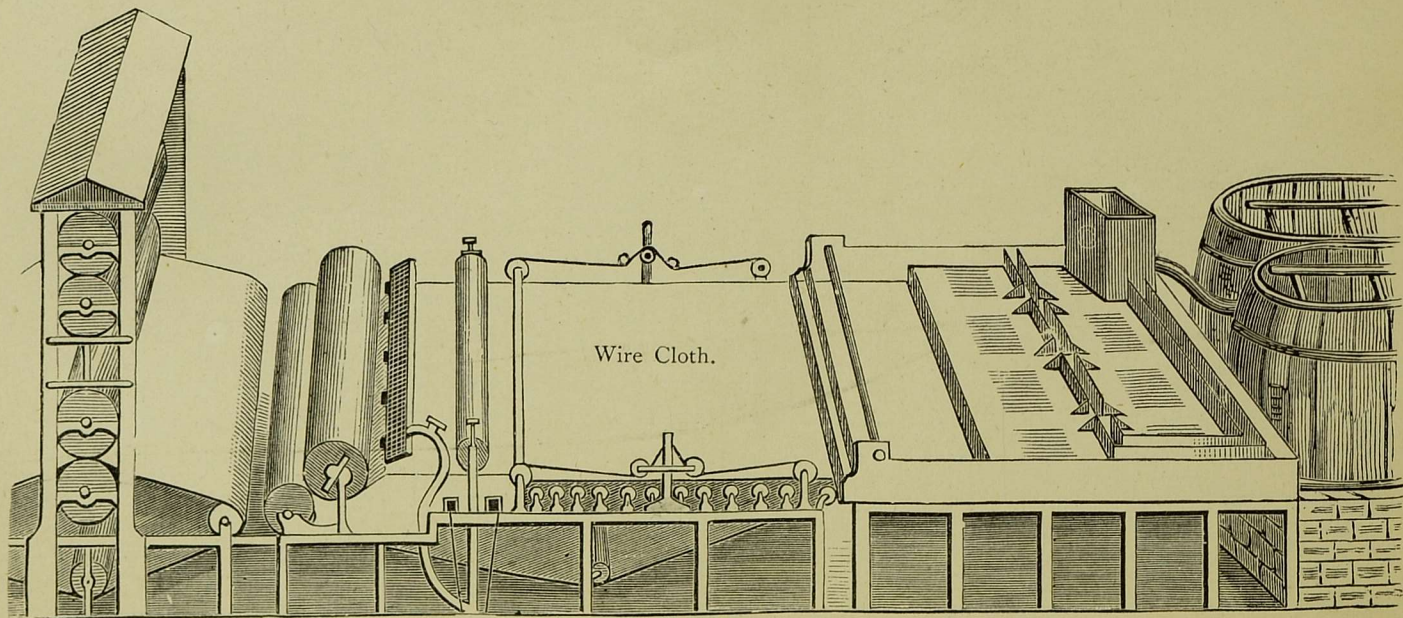
“Of course the Jews knew how to make leather ?” said Carrie.

“Most probably they did ; though Dr. Kitto says that they had great contempt for the trade of the *tanner*.

There are several allusions in the Bible to articles formed of the skins of animals which must have been *prepared* in some way, though how, we do not exactly know. We read of 'greaves' and 'girdles,' pieces of armour composed of leather, it is supposed; and of 'rams' skins dyed red,' for some of the coverings for the tabernacle. Most likely they derived their knowledge from the Egyptians, who certainly possessed the art. The sandal and the shoe were both made sometimes of leather, though by no means in all cases, as the Egyptian sandals were not unfrequently made of palm leaves and papyrus stalks interwoven. The 'shoe' and the 'sandal,' among Eastern nations, are often employed as symbols of various things; such as, the taking possession, or the transfer from one person to another of an obligation or a right. With Western nations, in the Middle Ages, the giving of a *glove*, served as a sign of the bestowment of lands and dignities.


"And here our 'THREADS' must really stop for to-night. I can but hope that as you have all so well performed *your* part of listening and learning, I may, to some extent, have fulfilled my part of our contract."

"Yes, indeed, you have, mamma," replied Sydney, in the name of the others. "You have proved that, as I said, *you* were the only right person to take up your own gage and draw out the 'THREADS OF KNOWLEDGE' which belong to A KID GLOVE."



PAPER-MAKING MACHINE.

A SHEET OF PAPER.

“ HE worshipful company of weavers here assembled,” began Sydney, with a profound bow, as he placed a chair for his mother at the next meeting, “are curious to know from what article their respected Minerva intends to-night to ‘spin a yarn.’”

“The humble deputy of that renowned and learned lady, Minerva, proposes that this evening *a sheet of paper* shall furnish the material for the said *yarn*,” replied Mrs. Norton, as she took the chair assigned her.

“All right, mamma, we are ready, though I don’t see how you can get much out of it,” said Arthur.

“I must do the best I can,” said his mother, demurely.

“I suppose we shall begin,” said Carrie, “by learning about the way in which paper is made in England at the present day.”

“Yes, but first of all, I should like to hear what

would be your answer to this question : 'What is *paper*?' You know a word that has been in use for a long time acquires a decided meaning ; it may not be the meaning that was first given to it, but it is the meaning that is likely to cling to it for a very long time at least ; now what is the present meaning attached to the word *paper*?"

"Oh, mamma, we all know what *paper* is," said Arthur. "It's anything you can write and print upon."

"But, Arthur, we can write upon slate and upon wood, and they are not *paper*," rejoined Maggie. "Can't we, mamma?"

"Certainly," replied her mother. "Arthur, therefore, has not given a *definition* of the word ; what do you say yourself, Maggie?"

"Paper comes from rags. I learnt that when I was a very little girl," said Maggie, triumphantly.

"That is true ; but that is only telling us one kind of thing from which paper can be made ; not what *it* is itself. What do you say, Carrie and Sydney?"

"Paper is something *artificially* made ; not a natural product," said Carrie, after thinking a moment.

"But the word comes from 'papyrus,' and the papyrus is a natural product," said Sydney.

"Keep that 'thread' of the 'papyrus' quite out of the way for the present, Syd," said Mrs. Norton ; "we will take it up before we have done. But I asked you for the present meaning and application of the

term, not for its derivation. Carrie's answer comes the nearest to what I want you to understand ; which is, that the word is not now applied to any *natural substance* prepared and made fit for use for certain purposes ; but is given to a substance that is produced by *artificial* means from the liquid pulp of the fibres of vegetables. The substance produced is quite different from that from which it is produced."

"Would any vegetable substance do for the purpose?" asked Sydney.

"Yes ; any whose fibres can be reduced to a liquid pulp. All kinds of things have been tried at different times. In the British Museum there is a book compiled by a M. Schäffer, before the year 1772, in which there are sixty different specimens of paper made from sixty different substances. You have all seen paper that has been made from straw. A Spanish grass called 'Esparto' is now largely imported, and greatly used. This grass also grows in Africa, and is named by the Arabs, 'Alfa.' Then in France and Prussia, in Derbyshire and South Wales, paper is being made from *wood pulp*. Some of our English paper-makers are also trying a new fibrous plant, the *Cineraria Maritima*, a sea rag-wort. But I believe nothing is found to answer the purpose better than the substances generally employed ; and these can be used after they have been manufactured into different things, such as linen and cotton goods, sails and cordage, &c., as well as when they are in their natural state."

"So now we come to Maggie's rags," said Carrie.

"Yes ; from old, dirty, worthless pieces of things that have once been good, can be made one of the most useful of all artificial substances—paper."

"Does it matter what kind of rags ? can coloured and dirty ones be used ?" asked Carrie.

"All kinds can be made to serve for some one or other of the coarser sorts of paper that are manufactured ; and even the coarse canvas bags in which the rags are packed, do for coarse kinds of paper ; but you can easily believe that the quality of the paper depends a great deal upon the quality of the rags, and the quality of the rags depends, on what do you suppose ?"

"Upon the people who have worn the clothes, perhaps," remarked Sydney.

"Yes, the dress of a young lady in a civilised country like England, will differ widely in material and cleanliness from the *kaross* or blanket worn by the Bechuanas of South Africa."

"I should say so," said Arthur. "But, mamma, do we get our rags from such a distance ? I should have thought we might have found enough in our own country."

"No, we have to import, it has been said, about one-seventh of what we use ; but we do not go so far as Africa for them, certainly," replied Mrs. Norton. "Italy, and the countries by the Baltic, supply us with the largest amount. Rag collecting is quite a distinct business in some countries, and I have read some exceedingly curious and interesting accounts of the ways

and habits of the *chiffonniers*, or rag-pickers of France. You can read about them for yourselves another day, we must not linger over them now.

"Then when the rags have been collected they must be *prepared*. The sorting of them is done by women and children."

"What a nasty, dirty business it must be," said Arthur, "it is a shame to make women and children do it——"

"But as it does not require much strength, it is so far suited to them," replied his mother. "A woman stands before a table covered with wire, with a heap of rags before her. On the table is a large knife placed nearly upright, and at the edge of this sharp knife she slits the rags into small pieces, cuts away hems, removes buttons and all hard things, and then throws the cut rags into different boxes, placed on each side of her, according to their fineness. The rags are generally divided into four different degrees of fineness. The *sorted* rags are then taken to a machine called 'the Willow,' which tears them, loosens their fibres, and shakes a good deal of the dust out of them and removes the grease. Then they are boiled in a mixture of lime and soda, which destroys any particles of the stem of the flax, or the husk of the cotton which often remain in the fibres (for these would be very injurious to the paper), and loosens the dirt from the texture of the rags. From the boiler the rags are taken to the 'washing engine,' which is a large iron vessel kept constantly supplied with water. In this

engine is a cylinder armed with knives, and under it is a plate, on which are placed more knives. The rags are thrown into the water, the water is kept moving, and the rags are forced between the cylinder and the plate and get, as you may suppose, well teased and pulled about."

"Poor rags ! I should think there was nothing left of them after such rough treatment," said Maggie, "but I suppose they are ready now to be used."

"No, not quite ; they have only been reduced to a pulp that is called 'half stuff,' and this 'half stuff' has to be bleached by chloride of lime, which turns them white as snow. At this stage, the pulp is tinted, if it is required. I think you know that the blue tint on paper is now given by ultramarine."

"What, that beautiful blue that cousin Lucy uses for her illuminations ? it seems much too good for that purpose," said Maggie.

"It is a beautiful colour, I know, and one that artists gladly make use of when it is prepared with oil. Of course when it could only be procured from the mineral lapis lazuli, which is found in China, Persia, Siberia, and the banks of the Indus, it was far too costly to be employed in manufactures ; but now that chemists have discovered the way to make artificial ultramarine as pure, and bright, and lasting as the natural colour derived from the stone, it is very largely used in manufactures as well as the arts. Do you know who first thought of giving a blue tint to the pulpy rags ? It is said the idea came from the wife of

a paper maker. She knew that the 'blue bag,' balls of indigo tied up in muslin, which our grandmothers employed in their washing operations, greatly improved the colour of her washed clothes; so she thought, surely it would have the same good effect upon the yellowish paper rags."

"Sensible woman," said Sydney; "that was using her own small experience to advantage."

"Now this 'half stuff,' thus bleached and blued," continued Mrs. Norton, "is finally taken to 'the beating engine' to be torn and ground into 'fine pulp' by a similar process to that employed in the 'washing engine.' In one engine of this kind, I have read that the cylinder has as many as fifty-four knives, and the plate seventeen. It turns round 150 times a minute, and makes no less than 162,000 cuts during that time. So now our rags are really ready for use."

"Stop a minute, mamma, let us count up how many different things have been done to them," said Carrie. "They have been sorted, dusted, boiled, washed and beaten, bleached, tinted, and then washed and beaten again."

"And 'sized,' as I ought to have told you," said Mrs. Norton.

"Well, now, mamma," said Arthur, "let us set to work and make our sheet of paper out of this pulpy stuff."

"Almost all our paper is now made by machinery," resumed Mrs. Norton, "but before I attempt to give you an idea of the way in which it is done, I think I

had better describe the method of *making it by hand*, because you will then better understand what are the main things that take place in the process of turning liquid pulp into a sheet of paper."

"There are two things that I must first describe to you. The one is called 'the mould' and the other 'the deckle.' The '*mould*' is a square, shallow, mahogany frame, made of different sizes, which is covered with thin 'wire-cloth.'"

"'Wire-cloth,' mamma," said Maggie; "that is a 'knot,' please untie it for me."

"It is simply very fine threads of wire laid lengthwise, so close together as to resemble the threads of cloth. These fine wires are crossed by a few stronger ones, laid at some little distance from each other.

"The 'deckle' is a thin frame made of the exact size of the mould. Now, suppose the liquid pulp all ready prepared is placed in a vat. A man takes up the mould, with the deckle upon it, holds them firmly together, dips the mould into the vat, and takes upon it as much of the pulp as he thinks will cover the mould a certain thickness. The deckle frame keeps the pulp from going off the sides of the mould. He then shakes the mould gently up and down and from side to side, that the pulp may flow about *evenly* all over the wire-cloth. The water drains through the meshes of the wire, and the fibres of the pulpy stuff arrange themselves over the surface of the wire-cloth. Setting the mould up for a moment to drain, the 'dipper, then passes it into the hands of another man, called

'the coucher,' who having first arranged a piece of felt, or thick flannel, turns the mould over on to it and the pulp clings to the felt. He gives the mould back to the dipper, arranges another piece of felt, and then lays another sheet of pulp upon that, and so on, alternately felt and pulp, felt and pulp, till 130 sheets are laid. Sheets and felt are then pressed. After this the sheets are strong enough to do without the felts, and are laid together and again pressed. They are then taken to the drying-house, and hung up on lines to dry. When dried, they are dipped in size or glue; the glue causes the pores to close up, and enables the paper to bear being written upon. The sheets are then again pressed, and again dried. Now this all sounds simple enough, but it is very slow work, and takes at least three weeks to perform. But by a machine *all these* different processes can be effectually gone through in *three or four minutes*."

"Oh, mamma, do you really mean it?" exclaimed Arthur. "Why, the machine must be a giant."

"Or at least worked by fairy hands," said Carrie.

"I mean just what I say, yet neither giant nor fairy will have aught to do with my machine; and with a little attention on your part, I think and hope I can make you, at least, imagine how the work is accomplished. I will only give you the principal parts of the process, leaving the details till you can see a machine at work for yourselves.

"Now tell me," continued Mrs. Norton, "what purpose did the wire-cloth serve?"

"It let the water pass through between the spaces," replied Maggie.

"And made a bed for the pulp to lie upon," added Sydney.

"Why did the 'dipper' *shake* the mould with the pulp upon it?" said Mrs. Norton.

"To make it spread evenly over the wire-cloth," answered Syd.

"Yes. To get this pulp to flow evenly over the surface of the wire-cloth, to cause it to lie at a *uniform thickness*, is a most important and difficult thing. Can you see any reason for turning the moist pulp on to the thick flannel as the 'coucher' does?" asked Mrs. Norton.

"Does the flannel help to suck away more of the water from the pulp?" said Maggie, hesitatingly.

"Quite right. The flannel not only absorbs more water from the pulp, but it helps to protect the tender sheets, and enables the fibres to bear the pressure necessary to render them compact and close.

"Now we can go on, and you will see that the machine can do all this far better than the hands of the 'dipper' and 'coucher.'

"Suppose the liquid pulp placed in a vat. Instead of dipping a mould into the vat, the pulp is made to flow evenly and gently out of a trough on to and over a piece of *woven* wire-cloth."

"Like the mould," said Maggie.

"Yes ; it answers the same purpose ; but there is this advantage in the wire being *woven*, and that is,

that all the wires are the same thickness, which, you remember, I said they were not in the 'wire-cloth' of the mould. The paper made on the moulds often shows the marks of the stronger wires; it is thinner in those places.

"This 'endless' web of fine woven wire (called 'endless' because it is made to pass over rollers, round and round, and do duty over and over again) may be thirty feet long, and twelve or fifteen feet of it are always ready to receive the constantly falling pulp.

"The wire-cloth is made by machinery to move slowly round, and there is also given to it an even motion from side to side."

"That is instead of the man shaking the mould up and down," said Arthur.

"Yes. As the water drains through the wire-cloth into a trough below called 'the save-all,' the fibres of the pulp arrange themselves over the web. Do you remember what purpose the 'deckle' answered?"

"It served to keep the pulp on the mould," replied Carrie.

"True; and on this wire-cloth are what are called the 'deckle' straps. These are made of large pieces of cotton gummed or sewn together, and sometimes of india-rubber. They are made to move with the wire-cloth, and can be placed near together or further apart, according to the required width of the paper.

"Paper made on this *woven* web of wire-cloth is called '*wove* paper,' while paper laid on a mould is

called 'laid paper.' Have you ever noticed marks and names on the paper, not written or printed on the surface, but formed in the very texture of the paper?"

"Yes, often, mamma," said Carrie.

"These 'water marks,' as they are called, are, when the paper is made by hand, formed by wires bent into the shape of the name or device, and sewn on to the wires of the mould. The old printers used to have many odd devices for their paper, and some of the papers of the same size keep the old names, though the devices are changed."

"Tell us some of the old names, mamma," said Maggie.

"Well," replied Mrs. Norton, "a fool's cap and bells' gave the name to the paper we still call 'fools-cap' paper. A postman's horn, such as they used to blow, marked the paper still called 'post paper.'"

"But let us come back to our web. When it is required to make a mark or name upon woven paper, it is done by means of a roll, called 'the dandy,' that has wires placed lengthwise on it. The bent pieces of wire that form the name are fastened on to the wire of this roll, and the cylinder is passed over the web of pulp. It not only impresses the required mark upon the paper, but it tends to make the fibres more compact. In some cases the web of wire cloth and pulp is made to pass over 'suction boxes;' that is, boxes out of which the air has been taken away, or exhausted by means of air pumps. Syd, you have recently had

the air-pump explained to you. Tell me what you suppose would be the effect upon the still moist pulp when the web of wire-cloth is made to press tightly over a space from which the air has been exhausted."

After a moment's thought, Sydney answered: "Would not the water from the pulp force itself into the empty box, to take the place of the air?"

"Quite right," replied his mother; "and by that means the web of pulp is forced to part with a great deal of water. Let us see now how far we have proceeded. We have got our web of paper, which has been formed upon the wire-cloth by the interlacing of the fibres of the pulp as the water passed away—it has been regulated by the deckle straps—made closer in texture by the pressure of the 'dandy' roll, or cylinder, which has also impressed the required mark upon it; and considerably dried by its passage over the 'suction boxes.'"

"What has to be done with it now? Can it take care of itself yet?" asked Arthur.

"Not quite. The wire-cloth and the paper web are both passed between two rollers, called the 'couch rolls,' and here the wire-cloth parts company with the paper web, and turns it over on to an 'endless' blanket of felt."

"I see," exclaimed Arthur. "These 'couch rolls' do the work of the 'coucher.' Really men are not wanted at all, it seems to me."

"You silly boy," retorted Sydney; "men have to

invent the machine, to make it, and to guide it. It is absurd to say *the machine* does the work."

"Do not take Arthur's remarks *au sérieux*, Syd. You know quite well all he means to imply," said Mrs. Norton.

"What becomes of the web when it is placed on the blanket? Please follow it on its journeyings, mamma," said Carrie.

"The blanket carries the web under two heavy rollers, called the 'press rolls,' by which a very great deal of the remaining water is expelled from it, so that the web can now bear its own weight, and may be gently handled. It is passed under a second pair of 'press rolls.' After this it is transferred to another blanket, while the first blanket rolls back again to take up another wet web. The web and the second blanket pass over several heated cylinders, each one of which is hotter than the preceding."

"I suppose that is instead of hanging it up on ropes to dry, as they did the hand-made paper?" said Sydney.

"True. The paper, thus effectually dried, is then wound on to a large reel, from which it can [be unrolled, cut lengthwise by machinery, and afterwards cut again into the different sizes.

"Now I have told you all the chief processes through and by which a quantity of liquid vegetable pulp is converted into the new, firm, compact, flexible, porous, smooth substance we call PAPER; and all these different processes can be effectually accomplished in the short space of three or four minutes."

“Hurrah for machinery!” exclaimed both the boys.

“There is just a little more to be done to our paper, especially if it is to be made very fine and glossy. It has to be ‘finished and polished.’ Women are employed to look over the piles of cut sheets, who lay the imperfect or damaged sheets on one side. They then place a sheet of copper upon each sheet of paper, till a handful, or about forty sheets, of paper are laid, when copper and paper are passed under heavy rollers, till the paper reaches the degree of polish considered necessary. The paper is then done up into quires. Each quire consists, Maggie, of——?”

“Twenty-four sheets, and there are twenty quires to a ream; so that makes 480 sheets in a ream,” replied Maggie, quickly.

“‘Ugly old tables’ are of use, you see, Maggie,” said Mrs. Norton, smiling; “but 480 sheets is the standard quantity for a ream of printing paper. For *writing* paper 432 is the number, and 40 of these may be damaged ones.”

“Oh, that accounts for finding so many bad sheets in my last quire of note paper,” remarked Carrie.

“And now that there is no excise officer required to weigh and mark the paper, it is ready to leave the mill and be sent abroad into the world.”

“And *one sheet* has been drawn out into ‘threads’ for our special benefit,” said Carrie; “thanks to you, mamma.”

“Let us still keep to our old plan,” resumed Mrs. Norton, after a short pause, “and first unwind

those of the HISTORY THREADS connected with our own country and times. I may, perhaps, as well mention that there are, in this present year, 1872, 273 paper mills at work in England; and in twenty-three of these, writing paper is made by *hand*. In Scotland there are sixty mills in working order."

"That seems to me a pretty good number for our little island," said Arthur. "How did we stand at the Exhibition of 1862?"

"Not high enough, I fear, to please you and Carrie; for France and Prussia were declared by the jurors to be *first* in the production of the superfine writing papers. Still, we did very well, and earned a fair number of medals, considering that only eleven manufacturers exhibited."

"Who first thought of making paper by a machine that can do so much and so quickly, mamma?" asked Arthur. "I do hope it was an Englishman."

"The brains of many Englishmen have helped to bring our paper machinery to its present perfection, the names of whom I cannot stop to tell you now, but which you can find out afterwards by following out the 'thread.' But the first idea of making a continuous web of paper by a machine is said to have occurred to a man, called Lewis Robert, who was a workman employed by M. Didot, a paper manufacturer in France, in 1798. At any rate, Robert succeeded in showing by experiment that it could be done."

"Well, I hope the master did not take the workman's honour to himself," said Sydney.

"No, not exactly. M. Didot recognised the cleverness of the idea, and helped his workman to carry it out still further; and you will be glad to know that the French Government rewarded Robert. Other French gentlemen worked out the idea in England. Improvements and inventions rapidly succeeded each other; and though the idea was only developed at the beginning of this century, yet by 1851 the English firm of Messrs. Donkin and Co. were manufacturing their 191st machine."

"But did they make no paper in England till these French gentlemen brought over the idea?" asked Carrie.

"Oh yes, there were plenty of comparatively small paper mills in different parts of the country. Hertfordshire had, and still has, a good share of them for such a small county. I can well remember several in the neighbourhood of the pretty, quaint, little town of Hemel Hempstead, near to which we once lived when I was young; and the other day I saw the very same names in the 'Paper Mills Directory' for this year. You can well understand that it is necessary to have plenty of water near to a paper mill; and certainly, as far as I can recollect, 'Frogmore' and 'Two Waters' must have answered that purpose extremely well."

"Why, the very names are enough to make one damp," said Arthur.

"Now, unwind the thread till you come to the year 1685. The French exiles who came to us in that year taught our people many things in reference to the art of paper-making."

"We are very much indebted to these same refugees," said Sydney. "They taught us a great many things. They must have been very clever in all branches of manufacture."

"Well, if they were clever fellows in *teaching*, we were clever in *learning*. Don't you think so, mamma?" rejoined Arthur, quickly.

"Most undoubtedly," replied his mother, smiling. "Maggie, who was reigning in England in the year 1588?"

"It must have been Elizabeth," replied Maggie, after a moment's thought; "for the date for James I. is 1603, and for Elizabeth 1558."

"Well done, Mag," said Arthur. "I shall begin to look with great respect upon our 'horrid dates.'"

"In the year 1588," resumed Mrs. Norton, "a poet—I don't know his name—wrote a book with this title to it: 'A Description and Discourse of Paper, and the benefits it brings, with the setting forth of a paper mill built near Dartford by a High German, called Mr. Spilman, jeweller to the Queen.'"

"That was well done of the jeweller," said Sydney.

"Elizabeth appears to have thought so, for she knighted him, and gave Sir John Spielman a licence for the sole gathering of rags for ten years. Unwind the thread a little further, and let us take a peep into the household book of Henry VII., and we shall see these entries: 1499. A sum of 6s. 8d. given to 'Tate of the Mylne;' and in 1498, 'a reward of 16s. 8d. to the paper mylne.'"

"Who was this 'Tate,' I wonder?" said Sydney.

"Perhaps it was a 'John Tate' who had a mill near Stevenage, Hertfordshire; but as there is but little said of him, I fear his mill was not a success," replied his mother.

"Do you know who built the *very first* paper mill ever built in England?" asked Maggie.

"No; and I do not think that is a question which history can truthfully answer. I believe the first notice of the manufacture in this country that can be really depended on is to be found in a book published by Caxton, the great printer, in 1490. But there is an allusion to a paper mill to be met with in one of Shakespeare's plays. When did a certain Jack Cade live, do you remember, Maggie?"

Maggie's answer not being ready, Carrie replied for her. "In the reign of Henry VI."

"Quite right; and if you look, at your leisure, in the 'Second Part of Henry VI.,' you will find that Shakespeare makes Jack Cade accuse Lord Say of having, among other misdeeds, 'built a paper mill, contrary to the king, his crown, and dignity.' So much for the state of paper-making in England. Let us go into other parts of the world. Both in France and Germany the art was more advanced than with us. There seems to have been a mill established at Nuremberg, Germany, by one Ullman Stromer in 1390. Early in the fourteenth century, paper from linen rags was made abroad; and there are also English MSS. on linen paper dating as early as 1340.

We find that paper from *cotton* was in general use even two centuries before. Charters upon cotton paper are mentioned in the twelfth century. The Arabs, or Saracens, as you know they are frequently styled, are said to have spread the knowledge of paper-making over Europe. They had early established themselves along the coasts of Africa. They had also conquered Spain, and in the beginning of the twelfth century had set up a paper mill at Zativa, in Valencia. In this mill the paper was made from *rags*, and we hear of other improvements following. This Spanish paper was widely celebrated."

"How strange it seems," said Arthur, "that these *Saracens* should have brought so much knowledge to Europe: tapestry and cotton, and now paper-making. I thought they cared for nothing but fighting."

"At first that was certainly their chief pursuit and greatest delight. They went into Central Asia, into Persia, India, and China; and wherever they went they carried their swords and their religion, and forced people to submit to the one and to embrace the other. But when they began to cultivate the arts of peace, they grew less ferocious. And not only so; they became renowned for their skill and learning in many arts and sciences. You can follow this 'thread' another time, and find out the different branches of learning that were successfully cultivated by the once wild and fighting Arabians. It is supposed that they brought the knowledge of the art of paper-making away with them from China."

"The Chinese seem to be always the first in discovering the way to do things," said Sydney.

"Yes ; and they keep the knowledge all to themselves behind that high wall of theirs, the sneaks ! I am always glad to hear of their being outwitted," rejoined Arthur. "I cannot imagine how they come to be so clever."

"I cannot tell you, Arthur, how it is ; but it is certain that they have ever been a clever, industrious, economical people. They are exceedingly ingenious as regards this subject of paper-making. They use very many different kinds of substances—silk, cotton, hemp, rags, rice, the bark of the mulberry, and the young bamboo. If we were to unwind this particular thread about Chinese paper-making as far as it would go, I cannot say how far back history or tradition might not take us. Some say they knew how to make paper in the year 160 B.C. ; but for that I will not vouch. It is also said that they used paper made from the mulberry-tree as *paper money* long before such a thing was thought of by European nations.

"The paper the Chinese make from the bamboo is very soft and smooth, and takes impressions very well. We use a species of it, called 'proof paper,' prepared from bamboo and cotton, for taking impressions of engravings. The bamboo is, as I think you know, a tall, hollow reed, growing sometimes as high as fifty feet. The leaves are oblong and oval, and sometimes eight or nine inches in length. The Chinese take the young leaves of the plant ; soak,

dry, and bleach them ; boil them in kettles, and mash them in mortars, till they are reduced to a pulp. A sort of glue, made from a plant called *kotung*, is mixed with this pulp, and moulds are then dipped into the mixture. A very great deal of paper is used in China, not only by the students and learned men, but, as one author tells us, they actually cover the inside of the walls of their houses with it, and make clever drawings upon the paper thus employed."

"Well, mamma, that is nothing wonderful. *We* cover the inside of our houses with paper," said Maggie.

"Yes ; but that is, comparatively speaking, a modern use of paper, and one that we derived from our distant friends. Besides, the Chinese paper-maker beats the English one, for I have read that he can make a single sheet that will cover the whole side of a moderately sized house. Now we are so far east, we may as well call in upon the Japanese, and examine their paper, made from the mulberry-tree. They boil the inner rind of the 'paper mulberry' till the fibres are quite soft, mix the pulp with a gummy substance, and stir the mixture till it has acquired a certain thickness, and can be poured into moulds.

"Now, all these various processes that I have mentioned—from the machine paper-making of European nations, to this Japanese method with the mulberry leaves—resemble each other in one point ; and that is, that in each of them vegetable fibres have been brought into a state of pulp, and the pulpy fibres have

re-arranged themselves so as to form a new material, which material is quite different from the substance from which it has been manufactured. This is, as you will see, quite another thing from the mere preparation of certain natural substances that serve as *substitutes* for what we call paper. For instance, the natives of India frequently use the broad leaves of the plantain, bamboo, and various other plants. In Ceylon, the leaf of the mountain palm, the *Corypha umbraculifera*, sometimes called the 'talipot tree' is used for all records of importance. All their sacred records are written upon leaves of this tree. The natives think very much of their grand, noble palm. The number of leaves rolled up like fans which a Cingalese nobleman is allowed to have carried before him by his servants, used to be regulated by law, and denoted his rank and wealth. You can hardly wonder at their delight in their tree, for you all know what a magnificent tree it is."

"I do not think I do, mamma," said Maggie, rather mournfully. "I think I mix up in my mind palms and plantains, bamboos and bananas."

"Because of the similarity of the first letters, I suppose, Maggie," said Sydney. "'Very like a whale,'" he added, *sotto voce*.

"I have a great inclination, Syd," said Mrs. Norton, "to make you give us a thorough account of all these trees; and I would do so, if I did not expect to find your knowledge considerably below your power of criticising others."

"Now, mamma, be merciful as you are strong," said Sydney.

"Yes; and tell us yourself a little about the palm. We all want to know for *certain*; it is so easy to forget what one only reads about in books," said Arthur.

Mrs. Norton looked as if she could easily believe that to be true in Arthur's case, and resumed. "The palm grows as high as fifty or sixty feet; some species even to a hundred. It has a round, straight stem, without any branch or division, the same thickness throughout, with a diameter of a foot or eighteen inches. Now, to our European ideas of tree beauty, this does not seem as if it could possibly be a thing of beauty; but its magnificent crown of large, hanging leaves must be a beautiful object to look at. The firm, shining, tapering stem of these leaves is from eight to ten feet long. Each leaf is divided, like a feather, into a great number of long, narrow, bright-green leaflets. At the base they are often three feet long, but not more than an inch wide. While the leaves are young, they are twisted and matted together with loose fibres, which open out and fall away as the leaf grows; but the leaflets never open out quite flat; they always have a ridge down the middle."

"Like the keel of my boat," said Arthur.

"True. I dare say you know the natives use these large leaves for their umbrellas."

"But, mamma, how can they climb up to the top to get the leaves, the trees are so straight and tall?" asked Maggie.

“In this way :—The lower leaves droop and wither every year, and as they do so, the natives cut them off, but in such a way as to leave a portion of the leaf-stalk close to the stem, and these portions serve as so many steps. In fact, the trunk of the tree is made up of the roots of leaves.

“But now we come to a plant, a mere reed, far more remarkable, at least in connection with our subject, than even the noble mountain palm. Sydney, I know you can guess what I am going to mention, for it is associated with a country you and I are fond of reading and talking about.”

Sydney answered quickly : “Ah, mamma, you mean the Egyptian *papyrus*. I have been longing to get to that. How did the Egyptians make their paper, and when did they *first* begin to do so?”

“We will leave the latter part of your question a minute or two longer, Syd,” replied his mother. “I think I had better describe the plant itself, before we talk of the process by which it was prepared for writing upon.

“The *papyrus* of Egypt, the one from which the famous paper was made—for there are certainly two or three species of the plant—is a reed or rush which grew on the banks of the river Nile, and around the pools formed by that river.

“The root is large and hard, about the size of a man’s hand. It is sometimes fifteen feet long, and its shoots fix themselves firmly in the mud. Long, sharp-ridged leaves surround the stalk at the base of

the plant. The soft, triangular-shaped stem is almost as thick as a man's arm at the base, but gradually tapers towards the top. It will sometimes rise as high as fifteen feet above the water, and on its summit is the graceful hanging plume, consisting of a number of very fine filaments, each thread having several florets, and the whole plume being enclosed in a calyx of thin, narrow leaves."

"Now, please turn this reed into *paper* for us, mamma," said Arthur.

"The stem was cut or slit up lengthwise with a fine sharp needle, and the thin plates (or coats that make up the stalk) were taken and laid on a hard flat table. Another layer of plates was then laid crosswise over the first. The plant itself contains gluten; so, when these coats of papyrus stem were moistened with water and well pressed, they adhered closely, and formed one compact sheet. This sheet was then dried, sized, and polished with a hard shell."

"Was this papyrus paper used very much by other nations besides the Egyptians?" asked Carrie.

"Yes; it was largely used for many centuries by other nations; and even in the eleventh century it was still employed. But in the twelfth it was superseded very much by the *Charta bombycinea*—thick paper of cotton—invented by the Greeks, who for many centuries carried on considerable manufactures of this material on the shores of the Levant.

"Unroll the 'thread' till you come to the seventh century, and you will find it most extensively used.

In that century the heavy tax upon it was repealed ; and Cassiodorus, an historian living at that time, congratulates the whole world on the fact."

"Who took off the tax?" said Sydney.

"The king of a nation that we are accustomed to speak of as 'barbarians.' Theodoric, King of the Goths, did this wise deed, which all modern nations would do well to imitate."

"Well done, barbarian !" cried Arthur.

"I suppose the Romans used this papyrus paper very much," said Sydney.

"Yes, indeed ; very large quantities were annually brought into Rome, especially during the reigns of the more peaceful of the emperors. The impost must have brought large sums to the Roman Government, for the duty laid upon the paper was very heavy. The most important manufacture of it was in Alexandria ; but the Romans found means greatly to improve the polish and finish of the paper. The largest and finest kind was called 'imperial,' and was used by the great men to write their letters upon. You may form some idea of the great quantity that was used in Italy, when I tell you that about eighteen hundred MSS. were discovered in the city of Herculaneum when it was disinterred from its ruins. You can remember when it was destroyed."

"About 70 A.D., was it not?" said Carrie.

"Yes ; and very many of these papyrus rolls were found in the library of a suburban villa, arranged in presses round the room."

"What a learned man the owner of the house must have been," said Arthur. "I never think of the Romans as poring over books, but always as fighting."

"Yes; but the Romans of the period we are speaking about, were a much more refined, educated, and, if you please, enervated people, than the old Romans of earlier days. But both Greeks and Romans used other things on which to write besides papyri rolls; as a slight study of your Latin or English Dictionary might teach you, or even your common spelling-book, Maggie."

"Why, mamma, there is nothing in them about that, I am sure; not that I ever saw," said Maggie, correcting her first assertion.

"If you never saw what I mean, Maggie," replied her mother, smiling, "it is because you have not learned how to find the treasures of knowledge hidden away very often in a single word. A word is frequently like a small chest or portmanteau with secret drawers, in which are shut up treasures of information respecting the manners and customs, ways of living, and modes of thought of past nations. We put our own meanings and our own thoughts into the word-chest, and many of us forget to look what else may be concealed there. For instance, the Romans used tablets made of leaves of various metals and tablets of wood. These were coated over with wax, and fastened together by rings at the back, through which a stick was passed that served as a handle by which to carry them. They used a metal pen, made generally of

iron, sometimes of gold, silver, and brass, one end of which was pointed, the other broad, in order to efface the writing if desired, and spread the surface over again. In order to keep the writing from being rubbed, there was a metal button in the middle of each leaf.

“Wooden tablets were still in use in Europe in the fourteenth century, and the wooden ‘tally,’ on which in the youth of your great-grandfather, people used to chalk their daily accounts, is a remnant of the ancient custom. The Romans kept a yearly record of their public matters, such as treaties and laws, upon tablets of brass—a fact preserved in our word ‘*era*,’ which comes from *æs*, *æris*, brass. Then they also prepared and used the leaves and inner bark of trees. Facts such as these are enclosed in different words; *e.g.*, in their word ‘*liber*,’ the bark of a tree, from which comes——?”

“Our word ‘library,’” exclaimed Maggie.

“Right; and in *folium*, *tabula*, *codex*, *scheda*, you not only find the different parts of a tree indicated, but the customs to which I have alluded. *Tilia* and *philŭria* were names for the linden-tree, and were applied also to the thin skin between the bark and the wood, and also to a sheet of paper.”

“And our word *paper* itself, does it not come from the Egyptian *papyrus*?” asked Sydney.

“*Papyrus* is the term bestowed by the Greeks upon the substance made from the Egyptian reed. Herodotus calls it the *byblos*, or *deltos*, perhaps in

reference to the locality where it *once* grew in such abundance ; and in that term you feel out the Greek *biblos*, book, and our word ‘the Book,’ or Bible. I have read in commentaries that the Hebrew word for the plant is *gome*, a word that has the meaning in it of ‘to soak or drink up’—a most suitable term for a plant which a Latin poet describes as ‘the soaking papyrus.’ The Greeks also called it *kartes*, from a word meaning to *cut*, in allusion perhaps to the *cutting* or splitting up of the stem of the plant. Hence comes also the Latin *charta*, and our English word ‘charter.’”

“But none of these are real Egyptian words, mamma,” said Syd.

“True ; neither can I give you positive information on that point. But I have read that there is a Coptic word (Copt is the term for the ancient Egyptian), *gom*, a volume ;—that is, according to the Latin meaning of that word, *völūmen*, a rolling—a name well applied to the *rolled* book of early days. Sheets of papyrus paper, or of any flexible substance used for writing upon, were *rolled* round a stick ; and if the roll was very long, upon two. A ticket with the name of the book was frequently fastened to the end of the stick. We still keep the word ‘volume,’ but give our own meaning to it.”

“Why did you say ‘*once*’ grew when you were speaking of the papyrus, mamma ?” said Sydney.

“Does it not grow there *now* ?”

“No ; it has become almost extinct in Egypt. Partly

through the reckless use of it, partly through the indolence and neglect of the people—the result of the indolence and tyranny of their rulers—the regular cultivation of it has been given up, and the plant has died away. You may find it, or a species very similar to it, on the banks of the Anapus, a river near Syracuse, in Sicily; in the neighbourhood of Jaffa, and a few other places, but not in its ancient home.

“And yet how luxuriant it was in the early period of Egypt’s history—how adored and cherished by the ancient Egyptian. No wonder it was the hieroglyph of his native land, for it was at once its glory and its strength, its beauty and its wealth. How refreshing it must have been, in that land of brilliant sky and burning soil, and where there was but little wood for shelter, to have looked upon the ‘forest without branches, the thicket without leaves,’ of this papyrus plant, as it gracefully waved its green plume over the margin of their river and its lakes. And the reed was as useful as it was beautiful. There were few things in the life of an ancient Egyptian that were not connected with it. From some parts of the plant he procured both food and medicine; while others served to make the cradle for his baby, the clothing, utensils, and furniture for his household, and the sails, cordage, and vessels by which he navigated his one grand river. He carried it in triumph before the chariot of his king, and offered it in sacrifice upon the altar of his god. When he walked among the corridors of the palace, or worshipped amid the pillars of the Temple, on every

side he would still be surrounded by his loved papyrus immortalised in stone ; for the Egyptian architect, taking it as his guide and model, had sculptured and moulded shaft and capital of the massive column in careful, loving, but not servile imitation of its stems and flowers. Then, if he were rich enough to build ‘an enduring house’ for himself after death ; he knew that the same plant in all varieties of form and stages of growth would be painted on its walls. He also knew that when his dead body was carried across that ‘silent lake, whose waters were never divided except by the rowers of the dead,’ that then he should still carry with him, as passport or charm, portions of the papyrus paper, on which would be sacred words from ‘The Book of Death ;’—and, better still, he knew that when his naked soul should have to appear in that dread ‘Judgment Hall,’ to be weighed in the scales and confronted with his own good and evil deeds ; that even there, in the midst of all that was strange and terrible, the same revered, loved, and familiar symbol would greet his eye, and precede him even into the awful presence of the great judge, Osiris. No wonder the papyrus was all in all to the ancient Egyptian.”

The children looked as if they also could share in the Egyptian feeling, and after a slight pause Sydney remarked : “I did not like to interrupt by asking you, mamma, but I used to think it was the *lotus* plant which formed the capital of the Egyptian column.”

“It was so used in later times,” replied Mrs. Nor-

ton ; "but in the early days it was the papyrus that was employed for the purpose. In the 'Hall of Columns' at Luxor, in Thebes, the artist has evidently taken the idea for the *shaft* of his column from a bundle of papyri plants tied together with bands, and has used the *unopened* buds for his capital ; while in the neighbouring temple of Karnac, the side columns of which in the central avenue are forty-seven feet high, the architect has employed the single stem and the full-blown flower. This reverent and skilful adaptation of the teachings of natural objects by the Egyptian artist might teach us in this day many a lesson we should do well to learn."

"You have said nothing about 'parchment,' mamma," said Carrie.

"True, Carrie. I ought to have stopped the 'thread' of the papyrus history at 200 years B.C., and have told you that a king of Pergamos, in Asia Minor, sent to Egypt for a great quantity of the papyrus ; but the King of Egypt refused to let him have any. He therefore set to work, and established a regular manufacture of the skins of animals. The material thus carefully prepared became very celebrated, and was called '*Charta Pergamena*,' from which our word 'parchment' is derived.

"But the skins of animals had been used for writing upon from the very earliest times. A Hebrew MS. roll was discovered in the record-chest of the Jews at Malabar which was extremely ancient, and said to be a copy of one brought to India by their ancestors,

who were dispersed abroad by Nebuchadnezzar. This roll consisted of thirty-seven skins dyed red, had 170 columns, each four inches wide, with forty or fifty lines in each column.

Linen was perhaps nearly the first substance used as a substitute for paper. Linen bandages, with hieroglyphics upon them, have been found on many of the Egyptian mummies. But the very first thing that would suggest itself as suitable would be, I should imagine, the rocks and stones by which people were surrounded, and the bricks they early learned to make. These certainly were the *first* history-books ever prepared. Happily, many of them have lasted to our day, and our learned men think no labour too great to bestow, in order that they may read and understand them.

“And now I think we have unrolled our ‘threads’ as far, at least for the present, as they can go. Lay them up carefully in your minds, and follow them out further whenever you have an opportunity. Remember that they are but a few ‘threads’ from that ‘endless,’ because infinite, web of knowledge, the weaving of which is for ever going on and on.”

“Let me have the sheet itself, please, mamma. I shall put it among my treasures, and then it will help me to remember some, at least, of the ‘threads of knowledge’ that can be drawn from a SHEET OF PAPER.”

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