accompanied by the process of twisting, which is done on special machines constructed for the purpose. They are mostly of the ring-spinning machine type, but are without the drawing rollers. These, however, are too far away from the main topic of this essay to admit of further notice.

To return to single yarn winding: The number of winding spindles required for a shed of 500 looms will be from 600 to 900, according to the class of work upon

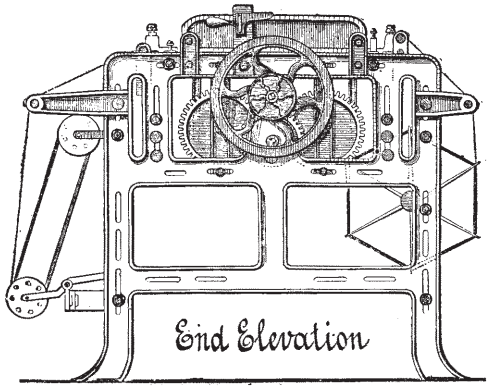

FIG. 206.—CUP WINDING MACHINE.

which it will be engaged. If the looms are making cloths containing from 15 to 20 picks per quarter inch, the smaller number will suffice. If, however, only from 6 to 15 picks are usually made the larger number will be necessary. The machines usually contain 300 spindles each, but are made to order of any size required. The speed of the spindles per minute is about 1200/1400 revolutions. The rate of the winding, however, varies all through the filling of a bobbin, being at its lowest when the winding surface is at its smallest diameter. The actual winding capacity of a machine will be obtained from the

revolutions of the spindle, and the mean diameter of the bobbin. From these particulars the manager will soon be able to calculate whether the capacity of the machines is equal or not to the requirements of the looms.

A strict watch should be kept upon the amount of waste produced in this department. To ascertain the percentages, the waste of the week should be carefully bagged in bags of which the tare weight has been taken. The total weight should then be ascertained. To this two

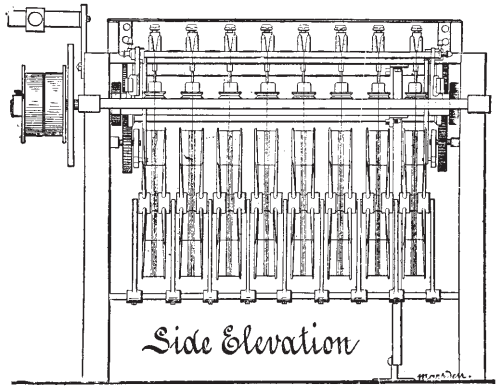

FIG. 207.—CUP WINDING MACHINE.

ciphers should be added, and this sum used for a dividend, the division being the weight of yarn weighed out to the winders during the same period. This will show whether the yarn is unduly wasteful or not. Of course the production of waste from each winder must be carefully examined, and all tendency to make an excessive quantity be checked. Care should also be taken that bobbins are not overfilled, as this causes waste by the yarn slipping off the sides. The temptation to overfill is that full bobbins wind the yarn more rapidly than empty ones, or "pieces" as partly emptied bobbins are usually called.

These partly emptied bobbins are what have been doffed from the creel of the warping machine. After having been once filled, bobbins are very rarely emptied, as it would seriously incommode the warper in "creeling" or refilling her machine with bobbins were this done.

The important point to be regarded in pirn machines is that they shall not glaze the yarn in the frictional contact that occurs, as this has a bad effect upon the appearance of the fabric which is woven from it.

WARPING.—Warping is an important process as regards the economical management of a mill, as considerable waste may be made in it if care be not taken. Of late, however, owing to improvements in the warping-frames, much of this liability has been done away with. An important point to observe is that all the machines should, if possible, be of one make, in order that they may register exactly the same length of yarn, and thereby prevent waste with each set of beams when finished in the sizeing-frame. Should any inaccuracy or difference exist between the register of these machines, one beam will be finished before the remainder of the set, or will contain a quantity of yarn when the others are finished, in either case entailing the necessity of pulling all the yarn off the beams remaining after the first has been finished, and throwing it into the waste bag. It frequently happens that several pounds of yarn are lost in this manner which could easily be prevented if proper means were taken. There is, however, a still more important point to be observed in connection with warping, as it is in this process only that loss can be prevented. In an establishment which accepts small orders of cloth, and makes many varieties, great difficulty is often experienced in making the exact quantities. The consequence is that either too many or an insufficient number of pieces are made, but mostly the former. As merchants generally refuse to take those made over the order, a great quantity of odd lots accumulate on the hands of the manufacturer, which have to be sold at a considerable sacrifice as "job lots." With the reduced profits that have been current for a long time, it will be obvious that the loss accruing upon these remnants of orders will considerably diminish the amount of profit upon the original one. With proper instructions and careful management there ought to be no difficulty in warping exactly the required length of yarn to suit any order; and the principal or the manager should probe every case of failure to the bottom, and see that those through whose neglect it occurred have the fact brought home to them, and be made to feel their responsibility.

The warping-machine beams should every one be carefully numbered and weighed, and the weights painted upon the flanges. A printed table of the weights of given numbers of "wraps" of different counts of yarns should be hung up in the room, and every full beam when doffed should be weighed, the weight chalked upon the flange, and compared with the calculated weight upon the table. This will show whether the yarns being purchased are true to their counts or not, and this will be the most effective check upon this important point. Where yarns are purchased from different mills it is highly necessary to see to this. It has also another important use: that of helping to keep the cloth of the right weight, as by this means sets of beams for the sizer can be made up of the right weight instead of, when no such care is taken, some sets running from 5 lb. to 20 lb. heavier than they should be, and others as much too light. These differences will be greatly increased after the sizeing process, the heavier yarn absorbing more size than it ought, and the lighter yarn less. The result will be great irregularity in the weight of the pieces of cloth, which no regulation by means of changing the counts of wefts will effectually correct. Trouble with the merchant will follow. All this may be avoided by care.

In a mill such as we are describing, containing 500 looms, five beaming machines, or one for every 100 looms

would be a proper complement. Should the work, however, be of lighter than average character, it would be well to have six or seven machines of a capacity of 500 ends each. A full description of the mechanism of this machine is given in a preceding chapter.

SIZEING.—This process in a manufacturing establishment is the most important of all. Though there are comparatively few operatives engaged in it yet more than half of the material consumed passes through their hands. Upon their efficiency and the careful performance of their duty depends to a great extent the success of the proprietors. The faults that either from neglect, inefficiency, or carelessness may arise in this department are very numerous and ought to be carefully guarded against, as their presence or absence may have much to do with rendering the fabrics produced either acceptible or otherwise in the market. It will be worth while to consider the process in brief detail, as if all is well managed here the subsequent operation of weaving is almost sure to be free from difficulty. We may here state that the preparation of the size—its materials, mixing, aging, storing, delivery to the machines—is such an important matter that it needs a brief chapter to itself, and will be found subsequently.

We exclude from notice the old system of ball-warp sizeing as a decaying one, and one which is generally carried on away from the manufacturing establishment, by people who make it a separate business.

The sizeing machines now generally used are of two kinds, the most common being the cylinder machine, so called from containing one or two cylinders, generally the latter. In this machine the yarn, after passing through the size, is carried round the surface of the steam-heated cylinder in order to dry it before it passes upon the loom beam. In the second form of the machine the yarn is dried either by hot or cold air. In this place it is not necessary to examine the respective merits of these two

forms of the sizeing machine, or detail the reasons which lead us, in common with the generality of the trade, to prefer the cylinder machine.

In the process of sizeing, the first point to be noted is that the yarn should not be subjected to strain at any part of the operation. The beams in the creel should turn or deliver the yarn to a very slight pull, and yet when the draught ceases should instantaneously stop, so that no slack should be made which would permit the yarn to run into "snarls" or kinks that might not be easily drawn out again. In order to prevent these it is usual to place a small roller across the yarn at a point near the size-box, which is fitted at each extremity into vertical-grooved brackets so that by its descent it can take down the slack, and so prevent their occurrence. Over the neck of each beam there should be a light pacing arrangement, consisting of a narrow leather band fixed at one end to a projection from the bottom of the frame, and thence carried over the neck, and having a small weight attached to the end. All the different working parts of the machine should be driven positively and not by the drag of the yarn upon them, and all the parts should be kept properly lubricated. Any strain is liable to destroy the elasticity of the yarn which ought to be carefully preserved to be available in the weaving process, in which the warp is usually subjected to a considerable strain. Yarn which is preserved from this strain in the sizeing process weaves much better, makes better cloth, gives a larger production, and owing to its greater freedom from faults commands a better price in the market. This is particularly the case when the fabric is intended for bleaching, printing, or dyeing.

One source of mischief in sizeing lies in over-drying. Cotton, which is a vegetable down, is covered by a natural gum which by excess of heat is liable to become hard, rendering the filament brittle. The same effect may spring from the baking of the size. The subsequent absorption of moisture from the atmosphere does not repair the injury,

as neither the wax covering of the filament nor the size dissolves again, or certainly not to a sufficient extent to enable the material to re-absorb moisture from the atmosphere sufficient to soften it for weaving properly.

One essential of good sizeing is uniformity. In an order for any particular cloth the warps should be throughout sized alike, whether the sizeing be done in one machine or a number. To accomplish this, after the size has been properly mixed, and has passed through all the successive stages of preparation, including boiling, that are deemed requisite, and is ready for use, it should be kept in a state of constant agitation so that it may be of uniform consistency when fed to the machine trough. The size in the latter must be kept at one level, so that the yarn in passing through it, may be always immersed to the same depth, and for the same length of time. This can only be maintained by an automatic feed tap for the sizeing trough. The size in the latter should be kept constantly boiling to prevent its heavier portions being deposited. After a stoppage of the machine for the day or meal hours, steam should be turned into the chamber, and the size be allowed to boil several minutes before the frame is re-started. The speed at which the machine is worked should also be as unvarying as circumstances will permit, and when working upon one order all the machines should run at the same rate.

Whatever be the system of sizeing employed, care should be taken to have the warp properly dried. When it is run upon the beam insufficiently dried there is great risk that before it can be woven through it may be damaged by mildew, sometimes to such an extent as to render it unfit for anything but waste. Where antiseptics are used this risk is diminished or obviated.

Much inconvenience and annoyance, and sometimes loss, arises from carelessness in marking the warp. It should always be seen that the marking-bowl is working properly and is provided with sufficient colouring matter. The mark should not be allowed to become too pale, because the

threads of the warp when passing through the healds being widely separated the mark becomes invisible and is frequently woven in without being noticed, and perhaps without an important heading, through the absence of which the piece is rejected. When a mark is too heavy, or runs into a long trail, it facilitates fraud by the weaver, who may draw the warp down as far as the trail extends or to the duplicate mark made by the offsetting of the proper mark, with greatly diminished risk of detection

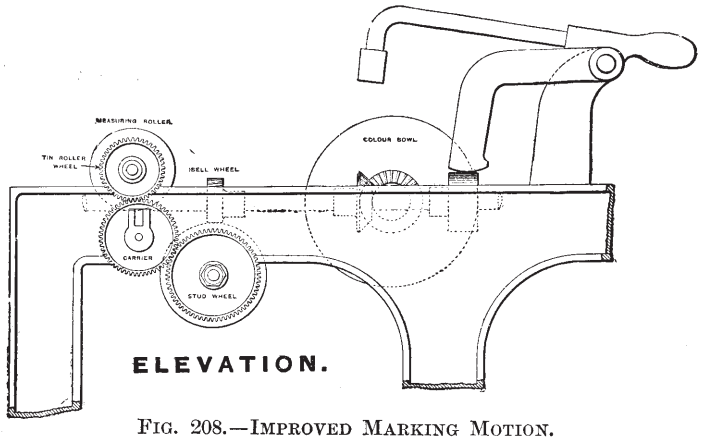

FIG. 208.—IMPROVED MARKING MOTION.

and so make the piece too short. A very excellent marking motion is the Hitchon patent made by Messrs. Howard and Bullough, Accrington. The following is a brief description with illustrations. The motion consists of three bowls geared together and operated by one driver, and constructed and arranged in such a manner as that when the centre one comes up a single mark shall be struck, this being intended to indicate the mid-length or middling mark, as the case may be. For heading or cutting-out marks, a double mark will be made by the two outside bowls being struck by the hammer. Along

the space left between these it is intended that the weaver should cut the cloth, thus separating one piece from another. The marks are made when the bowls present their flat sections to the stroke of the hammer, the rounded portions not being prominent enough to come into contact with the yarn when the hammer strikes. The hammer is con-

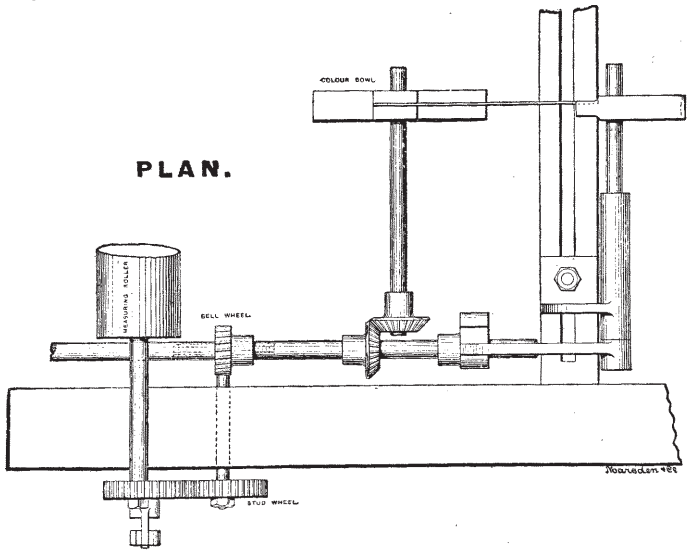

FIG. 209.—IMPROVED MARKING MOTION.

structed with three faces to meet the requirements of the change. These various points are illustrated in the accompanying elevation and plan, figs. 208, 209.

Should any of these points be neglected the result will be unsatisfactory; the warps will be too hard or too soft, too heavy or too light, leading to great difference in the weight, appearance, and feel of the cloth. So great is this difference at times that when the cloth is delivered to the merchant and examined by him, his suspicions are aroused that

the quality of the cloth contracted for is being tampered with, and deteriorated to his injury, when, in fact, the mischief springs only from carelessness and unskilfulness in the manufacture. But the dissatisfaction thus arising gives the merchant at home, or his customer abroad, a plausible excuse for heavily mulcting the maker in claims for abatements or in making rejections.

Every sizeing machine should have the beam presser as an attachment. This enables a greater length to be put upon the beam, which is economical. It also preserves the beam in better shape for the loom, and thus makes better cloth. Where the presser is not used, the beams in

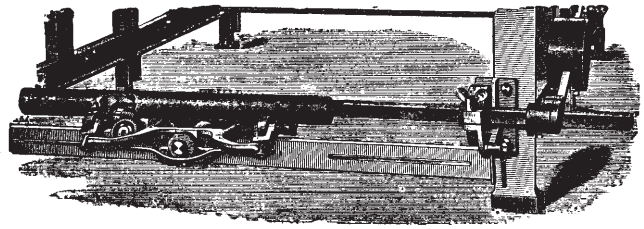

FIG. 210.—IMPROVED BEAM PRESSER.

being carried about frequently have their cylindrical form injured, by which the shedding of the warp in the loom is afterwards rendered defective, and inferior work produced. The presser consolidates the yarn as the successive layers are run upon the beam. The result is that much more length can be put upon them which is economical, whilst being made hard the beam preserves its shape better in handling. Our illustration shows an improved presser made by the firm just named. The presser consists of two lines of rollers, the one in front being made in two parts and tubular. This is mounted on a solid internal axle so as to be capable of expanding, the length over all being a little less than the width between

the flanges of the beam. This roller is mounted on anti-friction bowls carried in a suitable framing, but instead of the bowls having their axis parallel to that of the roller they are placed obliquely in swivel brackets which are capable of changing their position automatically. In whichever direction the peripheries of the bowls present themselves to the tubular rollers, the latter move towards or from the flanges. The back roller which is not an expanding one has its bearings formed so as to compel it to maintain a central position and thus to press the beam in the middle portion left when the front rollers have moved outwards. The general appearance of the presser is shown in fig. 210.

DRAWING AND TWISTING.—Drawing and twisting are such simple operations as to call for little more than a brief description.

Drawing, or drawing-in, is the name given to entering the warp into a set of healds which is done by an operative called a drawer-in, which may be a man or a woman. The process is as follows: The set of healds is suspended either from the roof or held up in a frame. Behind the healds the loom-beam with its warp is arranged parallel to the healds. The "drawer" takes his seat in front of the healds, and being provided with a single or double hook (the latter two hooks in one handle) for the healds, as the work may require, and a flat bone hook for the reed, he pushes the double hook first through two healds to the opposite side. There an assistant, a boy or girl, takes the first two threads from the warp and places them into the hooks, the drawer then drawing them first through the two healds, and next together into one dent, or split, as it should be called, of the reed. The child assistant is called the drawer's "reacher," because he "reaches" the threads to the hooks. This process is repeated until the whole warp is entered, when the task is completed, and the warp is ready for the loom.

A set of healds, however, if all goes right with them,

will weave from four to seven or eight warps. The second and subsequent warps, however, are not "drawn" in, but "twisted" in. This is a different way of effecting the same end. When the first warp is finished, instead of being cut out of the healds, the cutting is made through the end of the piece of cloth, thus leaving a "tab," which, on its side, holds all the threads of the finished warp in proper position. The "thrumbs" or waste end of the warp are next cut off on the opposite side, and either utilized by the weaver as thrumbs or passed to the waste-bag. The portion remaining in the healds is then tied up in several knots, so as to prevent any being drawn out. Thus the "set of healds and reed" are ready for the reception of another warp, or for storing away until required. In the former case they are suspended in a frame, and arranged opposite another weaver's beam containing a warp. The "twister-in," man or woman, then takes a seat between the beam and the healds, ties a given number of threads from the warp into a knot, then does the same with a similar number of those in the healds, and puts both sets of knotted threads into a peculiar shaped hook, called a twisting or looming hook. This done, he adjusts the tension evenly between the two sets, and with his left hand separates the nearest warp-thread from the bulk, and with his right hand the corresponding thread in the healds, with the same hand skilfully bringing the ends of the two threads together, he breaks them from their respective knots over the knife-edge of the hook, and deftly twists them together sufficiently firmly to enable them to be passed through the healds. In order to facilitate this process, both the warp and the yarn in the set of healds are furnished with a set of "lease" rods; or otherwise the warp has a lease "struck" by a comb. The new warp is thus entered or "twisted-in." This system is resorted to because it is more economical than repeated drawing-in. In the days of hand-loom weaving and the early days of power-loom weaving both these operations were done in

the loom, and hence were indifferently termed "looming" the warp, which might be either by drawing or twisting. The name of "loomer" is commonly given to the twister in the East Lancashire weaving districts to this day, but it is no longer strictly appropriate.

It is only needful to say further that the stock of filled beams should be so arranged that no damage should accrue to them before being taken to the looms. This is best insured by the use of the beam rack. This rack also admits of any beam of the lot being taken out without disturbing the others. The old method of making a pile upon the floor is objectionable, because by so doing the cylindrical form of the beam is crushed, and this tends to injure the shedding in the early stages of its weaving.

Healds and reeds should also be provided with racks in a dry room forming a store, where they should be assorted carefully, instead of, as is too common, being permitted to lie in heaps upon the floor, liable every moment to get entangled, broken, or otherwise injured. Before being put into store, reeds should be examined and repaired in order to be ready for use when required.

WEAVING.—This is practically the final process of manufacturing, and has been sufficiently described in the preceding pages. The chief essentials are first—good machinery; and, second, a good class of weavers. Where either one or both of these are wanting it is difficult to attain good results. When delivered from the makers new looms formerly required careful adjustment by a person having a practical knowledge of weaving greater than the fitters in a machine shop. In the looms now made by our best makers, however, owing to the special methods of production and finishing, and the care exercised in each department, it is rendered difficult for the fitting to be otherwise than right, hence it is seldom necessary now to spend much time or labour in "gating." The best tackler or overlooker should be selected for "gating," as it is called. An economical consumption of power, oil,

strapping, etc., along with the production of a large quantity and a good quality of cloth greatly depend upon this being well performed.

The tackler intrusted with "gating" new looms will require his usual equipment of a bench, containing a few small drawers and a cupboard for his stores. His tools consist of a round and flat file or two, screw-keys, gouge, small drill, small and large hammer, chisel, pliers, and a strong vice fixed to the bench. The screw-keys are, we believe, commonly provided by the tackler for himself, and are his own property. The materials required for dressing or equipping the loom ready for the reception of the warp are a driving-strap, two pickers, two picking-bands, check-strap and ends, two stud-straps, and four heald-roller straps. These straps or bands are all of leather, and of their sorts should be of good quality. The pickers are made of animal hides, differently prepared from leather, not having been subjected to the tanning process. Of course a pair of shuttles must be supplied.

Pickers should consist of as few pieces of the material as possible, and be thoroughly well put together. The work they have to perform, that of throwing the shuttle from side to side, is very severe, and unless they are well made of good material, and well seasoned, they become an exceedingly costly article in their wear and tear. They are received from the makers in a hard, tough, dry condition, and should be stored in a thoroughly dry place before being put to season. They are seasoned by steeping in good oil, in which they should lie two or three weeks, or even months would be better. When removed from this bath they should be hung up, to drain away all superfluous oil. If this be neglected, the oil will fly out of them when at work and stain the yarn or the cloth.

When a new loom has thus been equipped, it is usual to let it run for a few hours without warp, but supplied with a reed and a shuttle. By doing this any defect is detected, and the parts settle down to their work without

risk of any damage to the warp or cloth. When this has gone on long enough to obviate such risk, the loom is supplied with a warp, given in charge of a weaver, and its course of commercial industry commences.

The shuttle is an important part of the loom furniture, which in consequence of its severe labour, quickly wears away on three of its surfaces—both sides and the bottom. When it has become worn on the bottom, the cavity for holding the cop becomes reduced, often to a point beyond which it ceases to be an economy to retain the shuttle in use. The cop protrudes on the bottom side, and its friction upon the warp causes frequent breakages of both the warp and its own thread, besides a great deal of waste by breaking the cop. The condition of the pins which retain the shuttle-peg in position, should be kept good, as this has much to do with preventing weft breakages making good work, and securing a large production. The pegs should be kept firm in their proper position in the centre of the cavity of the shuttle. When the grooved side of the shuttle is worn, it should be renewed, which can easily be done by means of a round file of proper dimensions. The best wood for making shuttles is box-wood, but the diminishing supply of this wood, and its advancing price, has compelled resort to other hard-textured woods. Compressed woods have also been successfully introduced for shuttle purposes.

Shuttle boxes should be carefully set for the reception of the shuttle, so that it will get home without being knocked from side to side, whereby it suffers serious damage, the wear becoming excessive. The setting of the picking cone and position of the bowl on the picking shaft has also much to do with securing a good pick, the points to be observed being that the pick should be of proper strength for the width of the loom, and in proper time for the shedding motion. The warp should be adjusted in the loom, so that a minimum of strain and friction shall fall upon it. In shedding, the heddles should not be tied to go

higher than will give a clear passage for the shuttle, nor lower than the inclined plane of the slay forming the shuttle race. In either case it will be subjected to unnecessary strain, which will cause breakages of the threads, impairing the quality of the cloth, and diminishing the production.

The letting-off or pacing of the warp is an important matter, for where this is defective the cloth produced cannot be good; it will be either slack, strained, or uneven. Many attempts have been made to perfect the pacing arrangement, but it is questionable whether it is not still open to further improvement, especially for the lighter classes of fabrics. For different purposes different forms are preferred by scientific and practical manufacturers. For the ordinary work of the cotton trade the rope or chain, and simple or compound levers, generally suffice. To insure that the chain should not cut into the necks of the beam, these should be covered with metal collars or ruffles as protectors. They also form a smooth surface, giving uniform friction around their circumference, thus greatly assisting to produce uniform cloth.

A deal of trouble sometimes arises from the pikes of the beam ends coming loose and working out. This is difficult to remedy completely, and it usually means that the beam to which it occurs has to be discarded. There has, however, just been invented a combined pike, ruffle, and flange, which promises where adopted to obviate most of the troubles arising from this matter.

The taking-up gear of a loom is a most important matter. The ordinary system consists of a train of gearing actuated by a small horizontal lever, which operates a pawl engaging with a rack wheel containing 50 teeth. On the stud of this is fixed a change pinion varying in the number of teeth with the requirement. This pinion gears into a carrier or stud wheel, having 120 teeth. On the boss of this wheel a pinion of twelve teeth is cast, which gears into the beam wheel fixed on the axis of the

taking-up beam which is operated by it. The circumference of this beam is 15 inches. The number of teeth in the driven wheels by this system are multiplied together, when the total thus obtained will form a dividend; for this a divisor will be obtained by multiplying the driving wheels, and the circumference of the taking-up beam in quarter inches. In this case it is simply the fixed pinion wheel of twelve teeth multiplied into the circumference of the roller 60 quarter inches. Put in another form it will stand thus:

Rack wheel.		Carrier wheel.		Beam wheel.		
50	×	120	×	75	= 500.	
15	×	60			7·5	add
Pinion wheel		Circumference of beam in $\frac{1}{4}$ in.			507·5	for contraction.

Thus we see that 500 is the calculated dividend from this system of gearing. When, however, the cloth is removed from the loom, and relieved from the tension under which it has been woven, a certain amount of shrinkage takes place, which experience has shown to be $1\frac{1}{2}$ per cent. This is compensated for by adding $1\frac{1}{2}$ per cent. to the theoretical dividend just obtained of $500 + 7{\cdot}5 = 507\frac{1}{2}$. The half is disregarded, and the 507 taken in common practice. When it is desired to make a cloth to contain a certain quantity of picks per quarter inch, the number of picks wanted is used as a divisor, in order to obtain the change wheel. Thus suppose a 15 pick shirting is required: then $15 \div 507 = 33 + 12$. Here we see the remainder, 12, is more than half the divisor, and in consequence a 34 change wheel would be adopted. On these systems of gearing it is very rare that net results arise, and it therefore becomes a question on which side the balance should fall. It hardly needs telling that self-interest inclines the scale in favour of the clothmaker, and that he prefers to take half a pick to giving a quarter.

To meet these difficulties several improved systems of gearing have been invented, and have come extensively into use. Two of these were invented in Burnley, namely, Pickles' and Sagar's. The former has come most into use, though the merits of the latter are as great if not greater. Pickles' gear has a swing pinion of 24 teeth additional to the above gearing, and also requires a second change wheel to get its results, which are very good.

Sagar's taking-up gearing was invented by the late Thomas Sagar, loom maker, Burnley, whose long illness and death prevented its merits becoming widely known. This system contains the same number of wheels as the ordinary one, but the functions of two of them are changed. The change wheel of the former becomes a permanent wheel of 24 teeth in this, and the carrier wheel is made into the change wheel. This will give quarter picks. The result is remarkable, for any pick or fraction of a pick can be accurately obtained in halfs, with twelve teeth, quarters as above, eighths with 48 teeth, or sixteenths with 96 teeth, and finer subdivisions if wanted, which of course would never be needed for practical work beyond quarters or eighths.

This system offers a great advantage in its power of dividing the pick into fractions, not only because it will prevent disputes as to cloths containing the proper number which can be given with the greatest accuracy, but also the same accuracy will guarantee the most uniform results in the finishing of cloths, preventing differences of appearances that under the old system beget suspicion and disputes as to whether or not an order has been honestly executed. The economy resulting is also worth consideration as a merit.

THE WAREHOUSE.—There is little call for the use of machinery in the warehouse of a cotton manufactory. Two machines, however, are now almost invariably found in them at the present time. These are the plating machine and the bundle press. The plating machine is to displace the

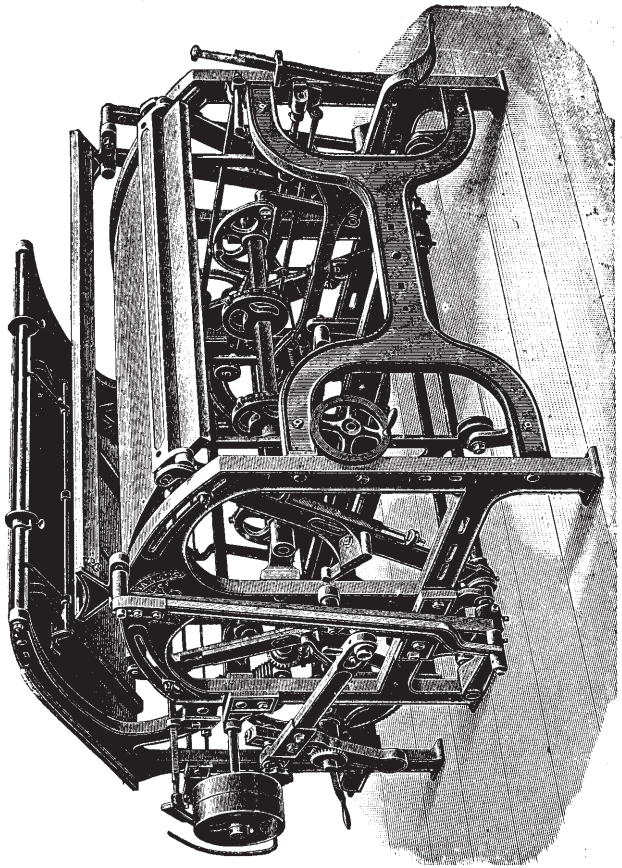

FIG. 211.—IMPROVED CLOTH PLATING MACHINE.

method of hooking by hand which is often objectionable because of the damage done to the cloth, caused by the perforations made by the hooks in the selvage. The plating machine, which is illustrated in fig. 211, as will be seen, consists of a strong iron frame. Inside the frame is a folding table, not flat, but constructed to form an arc of a large circle. This is arranged to move vertically up or down, and is guided by eight anti-friction bowls, two at each corner of the machine. Across the front and back, extending from one side of the frame to the other, is a grip rail or retaining bar, the under surface of which is clothed with strong card. The folding table is forced easily and constantly against the grip rails by means of pressure or balance springs, so that its top is always kept up to these rails when cloth is not intervening. The same influence holds the cloth in that position. The grip rails swivel on centres. They are actuated by a pulley or bowl carried on the side-arm, which, as the plaiter or folding-blade oscillates from side to side, comes into contact with inclined planes, and so alternately raises the rails. After the fold of cloth is laid, and the plater has passed away, the grip rails are pulled down by springs. The function of the plater is to lay the fabric upon the top of the table in folds in a straight and even manner. It is carried upon side-arms arranged outside the frame, and pivoted upon a bar extending across the middle of the frame at the bottom. The plater is a compound blade suitably curved for the purpose, and joined at each end, having a space left between its two edges. It is operated by means of a crank and arm of large sweep at the driving side, which is easily adjusted to make different lengths of a plate. In front of the machine there is usually a wooden box for the reception of the pieces of cloth. Taking the end of one of these the operative in charge passes it between the blades of the plater, secures it under the front retaining bar, and starts the machine. The plater then sweeps over the top of the table, carrying the cloth with it, which it presses

under the back retaining bar, by which it is held. Having completed its outward movement, it commences its return when its second blade comes into operation, and carries the cloth back to the other side, which it delivers to the front retaining bar, and thus forms a second leaf in the series of folds that are required for a piece. Owing to its peculiar mounting, the blades of the plater are swivelled to an appropriate position when approaching the retaining bars. The process is thus continued until the whole piece has gone through. As the folded piece increases in thickness the surface of the table is pressed downwards corresponding to the requirement until the piece is finished. The operative then, by means of a foot lever, depresses the table until the cloth upon it is clear of the retaining bars. At this position it is held by a detent, until the piece is withdrawn, and the end of another placed in the machine, when the work recommences.

The folded pieces from the hooking frame or the plating machine are thrown in a pile upon a large bench for the "maker up," a young man, who folds and assorts them according to their description, then ties them up in bundles of three, five, ten, or more pieces, as the case may be. If it be desirable that they should be pressed they are next carried to the cloth press, which may be a hand, steam, or hydraulic press. All of these are in use according to the requirements of the respective works. The press worked by hand is both slow and deficient in power; the steam press is quick in action, but for some work does not give pressure enough; the hydraulic press gives abundant pressure, but requires more time than is always available, so an improvement to meet the requirements of manufacturers has been invented.

In fig. 212, we illustrate an improved bundling press. In the arrangement of this press the table remains permanently in one position, and the pressure is brought upon the cloth by bringing down the top. This is accomplished by a small cross-shaft carrying the driving-pulleys.

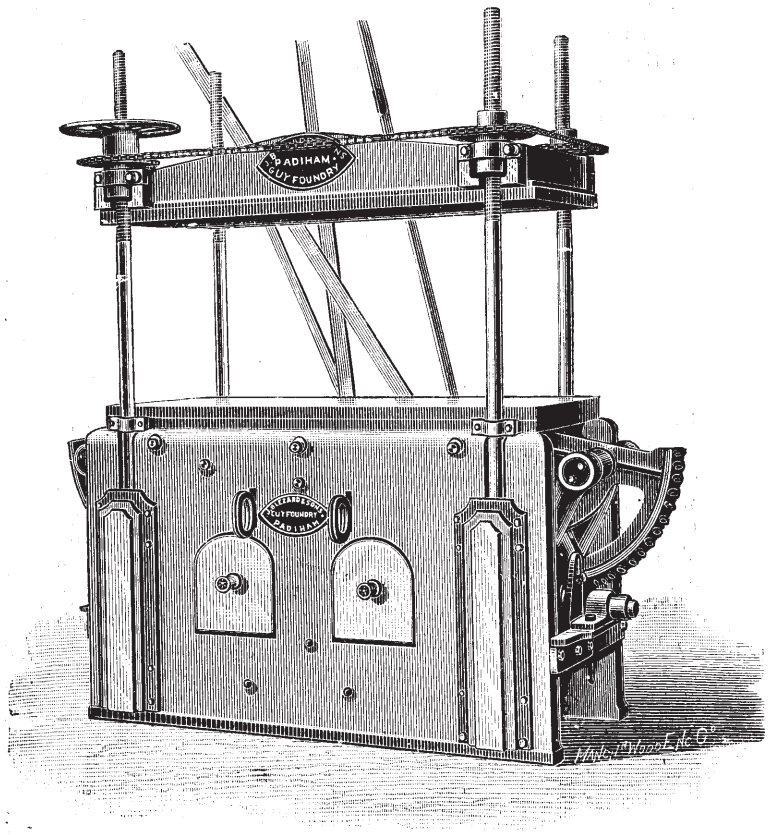

FIG. 212.—IMPROVED BUNDLING PRESS.

This shaft carries a level wheel gearing into a similar one on a longitudinal shaft. At the ends of this shaft are worms gearing into the quadrants, one of which is seen on the right of the illustration. The quadrants are right and left handed, so that they move outward and inward at the same time. Mounted upon the quadrants are connecting levers, so arranged that the action of the quadrants cause them to press upon arms attached to and extending inwards from the pillars, upon which the press top is mounted. The quadrant levers are so arranged as to bring very great pressure upon the pillars, by which the top is brought down very rapidly, compressing the bundles much more tightly, and very much more quickly, than can be done by any of the older types of presses. This is a great advantage, enabling the work to be got through much more quickly than before. To further accelerate the performance of the work there is a second pair of driving-pulleys, of half the diameter of the first. These are used for rapidly returning the top to its first position, when the pressing of a bundle has been completed. The larger ones are for bringing the top down upon the bundle. The handles for slipping the belts upon the pulleys are conveniently placed for the attendant. The top can be easily adjusted to the requirements of any size of bundle by means of the chain wheels upon the pillars.

There now only remains to despatch the cloth to the agents who may commercially handle it, or the merchant who may have purchased it. This is the stage at which the woven fabric usually passes out of the control and dealing of the manufacturer, and so naturally closes our journey with it through its various stages of production.

CHAPTER XIV.

Sizeing Materials and the Manufacture of Size.

The importance of size mixing.—The construction of cotton yarns.—The necessity and purposes of sizeing.—Organic and inorganic materials used in the composition of size.—The chemical composition of wheat flour.—Rice flour.—Maize flour.—Sago.—Corn starches.—Farina or potato starch.—The harshness of the sizeing materials, and the necessity of introducing softening matters; chloride of magnesium.—Heavy sizeing and mildew; legal responsibilities of the manufacturer.—Antiseptics; chloride of zinc.—Four prominent facts in sizeing.—Organic softening ingredients.—Tallow.—Palm oil.—Coco, castor, and olive oils.—Glycerine.—Irish moss.—Soaps; their composition, value, and uses.—Inorganic substances for weighting, deliquescent, and antiseptic purposes.—China clay; its origin, preparation, and chemical composition; qualities.—French chalk and terra alba.—Chemical salts: Epsom, Glauber's, and sulphate of baryta.—Deliquescents and their purpose.—Chloride of magnesium; its manufacture.—Care required in its use.—Chloride of zinc; value as an antiseptic.—Its chemical nature and manufacture.—Other antiseptics best avoided.—The blending of size; careful and thorough study of it wanted.—The progressive development of sizeing.—Mr. James Eastwood's inventions.—The mechanical size mixer and boiler of to-day.—Automatic drawing of the size.—Effectiveness and value of the mechanical size mixer.—Light, medium, and heavy sizeing, percentages of weight, and the cloths for which they are used.—Recipes for size mixings.—Weight in lb. of a gallon of chloride of magnesium, zinc, and water.—How to mix sizeing ingredients.—The steeping of flour.—Mixings for bleached and dyed yarns.—Sizeing of bleached and coloured yarns.—Dulling of colours by sizeing, and how to overcome it.—List of suitable colours for this purpose.—The proportions of water in size mixings.—How size mixings should "Twaddle."—The injection of steam weakens size.—Size mixing plant and sizeing machines should be placed near boiler.

IN the preceding pages a good deal has been said about sizeing, and the process and machinery employed in it has been fully described. But beyond incidental references, necessary to render clear the history of the develop-

ment of sizeing and sizeing machinery, nothing was said of modern size, its materials or methods of composition. The subject, however, was deemed to be of such importance that it was thought best to devote a brief chapter to the materials, composition, and treatment of modern sizes. As a preliminary to the perusal of this it would be best to re-peruse what has already been written upon the subject.

The warp yarns of nearly all classes of cotton fabrics require to be sized. This arises from the nature of the cotton down, and the mechanical structure of it, from which the yarns are made. These filaments are collapsed cylindrical tubes, having apparently corded edges. The end of the filament which was attached to the seed is open, showing its tubular structure; the opposite end tapers to a point, the tube closing and the filament becoming solid before the end is reached. This solid portion is more rigid and less manageable in spinning, it pierces the yarn, and projecting from the surface, gives it a downy appearance. These filaments in their different varieties range from about $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches in length. In the construction of yarn they are placed by the different processes as nearly as possible in parallel order. Subsequently the mass is attenuated or reduced to such small dimensions that on the final draughting the number of filaments in a cross section will not exceed the quantity required to form the desired counts of yarn. The spinning then immediately takes places in which the filaments are twined together upon a common axis. This causes them to interlock so much as to cohere and form a continuous line conventionally termed a thread. To get as much consolidation as possible, warp yarns are twisted to a greater degree than those intended for weft or filling purposes.

To any one who has examined a filament of cotton, it will be obvious that such treatment as described cannot possibly make a solid thread, as there must be many cavities in it owing to the imperfect fitting of one filament

against another. It will be equally evident that, owing to the short length of each filament, and its solid point, which is less flexible than the collapsed tubular portion, the former will project from the surface of the yarn, giving it a hairy appearance. This is precisely what occurs. Used singly and without further preparation the yarn in this form would be quite unsuitable for warp purposes owing to the strain and friction to which it is subject in the process of weaving. The purpose and function of sizeing is to more perfectly consolidate and strengthen the yarn by filling the interstices between the filaments with a starchy composition which shall adhere to and bind the comparatively loose filaments together, so uniting them that they shall practically form one. This is the first purpose. The second is to lay all the projecting points upon the body of the thread so that they shall not be torn away by the friction, the thread be weakened, and the cloth impoverished in consequence. There is also a third object sought to be obtained in sizeing, which in a sense and to a certain extent is an illegitimate one, not being necessary to the manufacture of yarn into cloth, but arising from the severity of competition. This is to obtain an addition to its weight. A blend or composition of flour, starch, and other materials, technically termed size, is the means used to attain these several ends. It is the materials and manufacture of this according to modern methods that we propose to describe as briefly as possible. The selection of the materials, the blending of them in right proportions, the methods taken to ensure perfect amalgamation, and the subsequent application of the size in the best manner to the warp constitute the most important operations in the manufacturing division of the trade.

The materials used for the composition of sizes for manufacturing use may be grouped in two classes, organic and inorganic. The former mainly consist of wheat flour, rice flour, maize flour, farina, sago, and dextrine. The inorganic materials are mainly kaolin or china clay, chloride

of magnesium, and chloride of zinc. In addition there are a few other matters used in very small proportions for colouring or bleaching purposes; these are so small, however, that they hardly need be taken into estimation in this connection.

Wheat flour, though not always most abundantly present, or even present at all in some cases, may properly be termed the principal element in the manufacture of size, as generally compounded. It is simply wheat ground down into a very fine state, and having the bran or husk of the grain separated from it. There are a number of varieties of wheat, and different blends of these are made in order best to meet special requirements. This is the miller's task. Flour for sizeing purposes is, to some extent, a specialty and particular attention is therefore generally given to its manufacture. It should be white, sweet, free from any bad odour or acidity. Starch is the principal element in flour, amounting to about 66 or 67 per cent., gluten is there to about 11, and water to 16½ per cent. The remainder is made up of fats, sugar, gum, dextrin, and mineral matter in diminishing proportions. These proportions vary somewhat according to circumstances. The starch and the gluten are the elements chiefly useful in sizeing. Gluten is a more powerfully adhesive body than the starch, but the latter is quite strong enough for the purpose, and to carry other ingredients of the size with it in any required proportion, so that it is not necessary to specially select flours having large percentages of gluten. Sizeing flour, when such is known to be its destination, is liable to adulteration, the adulterant being usually rice flour, though sometimes sulphate and carbonate of lime are resorted to. Should size, during the course of manufacture, not behave in the usual way, or in use not give the anticipated results, recourse should be at once had to the flour, which should be carefully examined and, if necessary, chemically tested. If either quantity or quality of the essential elements to make good size are not

present, the size will not do the work expected from it. This will result in bad work, annoyance, and loss.

Rice flour is the ground product of the grain named. It is the seed of the *Oryza sativa*. It differs considerably in its chemical composition from wheat flour. It has a crisper, harsher feel than the latter, and is easily distinguishable from it. It contains about 75 to 85 per cent. of starch, nearly 10 per cent. of water, and nearly 7 per cent. of nitrogenous substances, the balance being made up of fat, cellulose, grain, sugar, etc., in small proportions. Its adhesive property is not so strong as wheat flour, and it will not carry as much china clay through the healds and reed as the latter. With suitable softeners it forms a good light size for weaving purposes, but should not be used for weighting with.

Maize flour, otherwise Indian meal, is the ground fruit of the *Zea Mays* or Indian corn plant. It contains from 55 to 65 per cent. of starch, about 10 to 12 per cent. of nitrogenous matters, is rich in fats, having 11·10 per cent. The remainder is 14 per cent. of water and balance salts and ash. It does not favour mildew so much as wheat flour, but owing to its colour it is not much used as a sizeing ingredient. The starch from this plant, commonly known as Indian corn flour, is a good sizeing material.

Sago is a starch, generally miscalled flour amongst merchants and sizers owing to its being sold under that name. It is the pith of several varieties of palms, extracted, dried, ground to powder, mixed with water and strained through sieves. Washed and dried it forms a fine starch powder which is imported largely into this country under the commercial name of sago flour. It is used for sizeing the better and finer classes of cotton goods. Like rice starch, it soon becomes watery and loses its adhesive quality. It should not, therefore, be made in advance of immediate requirement.

The starches from the real grain flours are also used to some extent in sizeing. Wheat starch makes a strong,

stiff paste, which can carry a large amount of the less adhesive ingredients of the size. Rice starch is a fine stiffening article, but for several reasons only meets with a very little demand from the sizer; it is in much more request amongst bleachers and finishers. There are several other starches, but they are not known in the sizeing room, except one of them, and this is potato starch, which occupies such a prominent position that it is entitled to a more detailed description than any of the above.

Farina, or potato starch, is produced from that well-known tuber which is such a universal article of diet in the temperate climates of the world. The potato in its natural condition consists of about 74 per cent. of water, 20 of starch, 2·17 nitrogenous substances, 1·65 cellulose, 1·07 gum and sugar, ·10 fat or oily matter, and 1·01 ash. In manufacturing the starch, the tubers are rasped down to a pulp by mechanical appliances. This pulp is mashed with cold water, the whole being received into a trough where the starch granules being of heavier specific gravity than water, settle at the bottom. The water is then run off and the starch is then forced through fine sieves, leaving the cellulose behind. The moist starch next has the water extracted from it by a hydro-extractor, after which the drying is finished by laying it, placed upon linen cloths, upon bricks or slabs of gypsum, to dry. It is next placed in dry rooms with a temperature of about 60 degrees, where it yields up still more of its moisture. It is then reduced to the state in which it is offered as a mercantile article.

There are several other materials in the list of size components, but relatively they are of little importance. Those already described compose probably 95 per cent. of the whole of the materials used for the primary purpose of sizeing, namely, consolidating the filaments of the thread, laying upon the surface all the projecting points, and causing the mass to adhere closely and firmly together.

Early experience amongst weavers showed that the

flours, starches, and other materials used for sizeing nearly always resulted in leaving the sized yarn hard and comparatively inflexible, causing far too much breakage. This was one of the causes which led the weaver to seek damp and moist locations for his loom, and when these were not easily attainable, to create an artificially moistened atmosphere around him by placing water under his loom, either in the "treddle hole," or in dishes, so that the evaporating water rising under the extended sheet of his warp should give it the desired softness. Tallow, oils, soaps, etc., all softening ingredients, soon followed, each being more or less of an improvement, but all leaving a something wanting still to perfect the condition of the sized warp. There were three states of the weather in which the weaver found himself placed at considerable disadvantage as compared with average ones; these were: in the dry heats of summer; when dry east winds prevailed; and in the dry frosts of winter. In all these cases his warp yarn broke much more frequently than was desirable, deteriorating the quality and reducing the quantity of work he could get through, and at the same time demanding more attention and increasing his labour. All the trouble was caused by the abstraction of moisture from his warp. This he wanted to counteract, and in his quest for means to do it, amongst other things stumbled upon common salt, chloride of sodium, the affinity of which for moisture was universally known. The stroke of genius in this case was in discovering its suitability for, and its application as a warp softener. It was an advance. As time went on the sizeing process began to be used as a means of adulteration, and more powerful softeners were wanted. The chemist had now begun to take cognizance of the wants of the sizer, and he came forward with chloride of magnesium. Good again; this seemed to have perfectly solved the problem. Any amount of size could be put upon the warp, and it yet be maintained in a weavable condition.

As a result of this discovery "heavy sizeing" came into

vogue. In the manufacture of cotton cloths for export in the grey or natural state, the proportion of cotton speedily diminished, whilst that of flour, starch, and other sizeing ingredients increased. But a new difficulty arose: heavily sized goods, when they had been transported to the eastern markets, began to turn out in an unmerchantable condition; instead of fabrics, masses of brown, yellow, and decayed textures were unfolded that would not bear their own weight. The increased amount of nitrogenous matters put upon the warp had formed an excellent soil for the development of fungoid growths or mildew, and this had done the mischief. At first it was thought it was accidental, but its steady increase led to investigations, as merchants found that the exportation of grey goods to foreign markets was becoming far too risky and involved too much actual loss to be followed. At length one or two specially bad cases were taken into court, and claims brought against the manufacturers for heavy damages. The plaintiffs won the suits, it being laid down by the judges that a manufacturer was bound to deliver goods free from any latent defect that could not be discovered at the time the goods were received by the purchaser, and that he must be held responsible for damages resulting from its subsequent development. This settled the matter of mildew claims, and this ruling remains law to this day. The manufacturer had then to meet new and hitherto unknown risks.

Again the chemist was forthcoming to help him over the difficulty. It was discovered that chloride of zinc was a powerful antiseptic. Half-a-dozen other articles were also tried with success, but zinc proved itself so efficient that everything else has been abandoned, and now little is heard of mildew in grey cloth from any quarter of the world.

This brief sketch brings four facts prominently into view: first, that sizeing is for the purpose of consolidating and strengthening the yarn that is subjected to the process; second, that tallows, oils, and waxes, as softening anti-

frictional ingredients, were required for keeping the yarn supple, and diminishing the friction of its passage through the healds and reed; third, that deliquescent salts are required to retain the natural moisture in the cotton fibre under varying atmospheric conditions, and if possible to attract more; fourth, that the before-mentioned materials are used as the vehicle for carrying others called weighting ingredients, introduced to improve the appearance of the fabric, and reduce the cost of production.

The softening ingredients, which now call for brief notice, with few exceptions range themselves under the head of organic materials. These are animal fats; palm, coco, castor, olive, and other vegetable oils.

Tallow is the fat of animals, and chemically consists of about seventy-five parts stearine, a hard, solid fat, and twenty-five of olein, an oil. It is extracted from the animal tissues mainly by heat, the process being termed rendering. The skin and tissues next have all the fat pressed from them. The latter is then clarified by being remelted in water, the clear fat rising to the surface, and the impurities sinking in it. The fat drawn off is the tallow of commerce. Russian tallow is the best for sizeing purposes, as it is harder than most other sorts, combines readily with the components of the size, and when on the warp holds them with more tenacity.

Palm oil is obtained from the fruit of a palm-tree indigenous to west tropical Africa, whence it has been introduced to the West Indies. It is one of the most valuable exports of the West Coast of Africa. The oil has the consistence of butter, is yellow in colour, mild in flavour, and has an odour of violets. It easily becomes rancid. Its colour unfits it for use in sizeing until it has been bleached. But as a bleached oil it is used as a softener, mostly in connection with sago sizeing.

Coco, castor, and olive oils are all well known vegetable oils, but though sometimes used in sizeing, are not of such importance as to require description.

Glycerine is a sweet syrup derived from fats and oils, both vegetable and animal. It is a cheap and valuable softening article, highly suitable for sizeing purposes, on account of its hygroscopic properties by which it will retain China clay upon the warp when the fats and oils would drop it. Care must be taken not to use it in excess, or the cloth will have a tendency to become damp to the feel.

Irish moss is an edible marine algæ, rich in mucilage, and sometimes used as a softener for other ingredients of size.

Paraffin is used in sizeing cotton goods not intended to be bleached, dyed, or printed. It is unfit for cloths intended to undergo these processes, as it cannot be scoured out by the usual agencies, and so practically forms a resist against either a bleach, dye, or print. Manufacturers who use this article in their sizeing process should be careful to ascertain the subsequently intended treatment of their goods, and if for the above purposes should suspend its use whilst such orders are passing through the sizeing-room, in order to avoid complaints, annoyance, or claims for damages.

Soaps of one kind or another very frequently form an important element in the composition of size. They are manufactured from animal and vegetable fats and oils, which are combined with alkalies. They vary greatly in real value to the sizer, as they can be made to carry large percentages of water. This of course is of no use, and ought not to be paid for, as it can be added without cost from other sources. What should be looked for in sizing soap is as large a percentage as can be obtained of the fats and alkalies in their combined form. Good soap is valuable in pure sizeing from fermented flour, the alkali neutralizing the acid it may contain developed from the fermenting process. It also dissolves the fats, and insures their more perfect blending with the other ingredients. The cloth made with it is soft and pleasant to the feel. Messrs.

Davis, Dreyfus, and Holland, in their well-known work upon "Sizeing and Mildew in Cotton Goods," give this caution, however, regarding the use of soaps:

"Soaps must not be used in sizeing if salts of the alkaline earths are present, since the fatty acids of the former produce insoluble combinations with them, which not only render both the soap and mineral salt of no avail, but the size becomes lumpy and filled with clots."

This about exhausts all that need be said regarding the organic materials employed for softening the other ingredients of size.

The next and last division comprehends nearly all the inorganic or mineral substances which are introduced for weighting, deliquescent, and antiseptic purposes.

China clay or kaolin is by far the most extensively used of all ingredients for giving weight and body to sized yarns. It is a natural production of Cornwall, where extensive beds of it are found at St. Austell's Bay. It is simply disintegrated felspar, and is obtained by directing a stream of water against the deposit, and separating the kaolin from the mica and grit by washing. The milky-looking stream as it runs off is directed into tanks in which the heavier portions and impurities which the stream may have brought away are deposited. The water still holding in suspension the finer matter, overflows from the first into a second series of tanks in which the suspended mineral is deposited. As these are filled in succession, the snow-white mud is drawn off into still lower tanks, where it condenses into a stiff paste. When this stage has been reached it is cut into blocks and exposed to the air, or is dried by artificial heat in suitable chambers. It is then ready for the market. Chemically regarded it consists of about 47·50 per cent. of silica; 38·50 per cent. alumina; and 12 per cent. water. The balance is made up of traces of other minerals.

There are many qualities of this article in the market. In purchasing it for sizeing purposes care should be taken

to select it as free as possible from imperfectly disintegrated portions of felspar, sand, and other impurities. The colour should also be as white as possible, neither yellow nor pinky.

French chalk, otherwise silicate of magnesia, and Terra Alba, or sulphate of lime, are sometimes mentioned in connection with sizeing, but that is not their chief sphere of utility; though occasionally used, they are better known in the bleaching and finishing processes.

Epsom salts, or sulphate of magnesia; heavy spar, or sulphate of baryta; and Glauber's salts, or sulphate of soda, are three sulphates that were more heard of as sizeing ingredients some years ago, when the art was passing through the experimental stage, than at present. They are seldom used now. The first and the last named are principally used in this connection for the stiffening after weaving of coloured goods such as Oxford and Harvard shirtings. They give a harsh feel to the goods if used alone, but this is neutralized by the introduction of the mucilage of Irish moss.

The inorganic materials we have described up to this point are mainly used for weighting purposes.

There remains the pure deliquescents, which though important, will only require a brief description. The function of these is to retain the moisture naturally present, and to attract more up to a given point from the atmosphere. They preserve the strength of the yarn by keeping it soft and flexible, and add to its weight by their attraction of moisture when there is plenty in the atmosphere.

The deliquescent salt most extensively used in sizeing is chloride of magnesium. It is commonly but erroneously called "antiseptic." It has, however, very little if any antiseptic power whatever, but was given the name on its introduction owing to a mistaken belief that it possessed it. It must not be relied upon in this respect. Chemically it is a combination of the metal magnesium with

chlorine gas. It is a bye product from the manufacture of chloride of potassium. The liquid producing it is evaporated to the point when crystalization commences. It is then stored in casks where this continues until the mass become solid. This is its mercantile form. It is used in Germany for the manufacture of artificial marble, in France for the making of magnesia cement, and in England for sizeing purposes. Its great value depends upon its high deliquescent property. If a small quantity be exposed to the atmosphere it will absorb moisture at such a rate as to soon become liquid. This shows that when used as a sizeing ingredient, it will in most states of weather preserve the yarn moist, soft and flexible, the best condition for weaving. Care should be taken to purchase it free from oxide of iron which tinges it yellow, and from the sulphates and chlorides of potassium and sodium, and especially chloride of calcium which would have detrimental results.

In compounding size when it is intended to use chloride of magnesium, soaps should be kept out of the mixture, as they would be decomposed and an insoluble compound be formed. It should not be used in goods that have to be hot calendered, as it is decomposed by heat and the acid set free would tender or destroy the cloth.

We now come to an equally, if not more, important element in the composition of size. This is chloride of zinc. The powerful antiseptic property of this salt has proved a boon to the cotton manufacturer. The law held him responsible for the development of mildew ravages after the goods had long left his possession and when he could no longer exercise control over their disposition or storage in places that would favour the origination of mischief from septic sources. The use of this material, however, in his size, practically sets him free from all risk, as introduced in the proportion of 8 per cent. of the size it completely destroys mildew spores or produces such an uncongenial soil as to render their development impos-

sible. Very little is now heard of mildew in cotton cloth.

Chloride of zinc is a compound of zinc and chlorine. There are various methods of manufacturing it. The usual one is by adding hydrochloric acid to metallic zinc. This dissolves the zinc, the result being the chloride of zinc. In purchasing this article for sizeing purposes, care should be taken to have it free from adulterations which are usually the chlorides of sodium and calcium. It should also be perfectly free from iron, which would discolour the cloth. A sample of very good chloride of zinc would give in analysis about 48 per cent. of actual chloride and 52 per cent. water. It should not contain more than minute traces of other matters.

There are a number of other articles sometimes spoken of as antiseptics, but the manufacturer will do well to avoid them and persistently avail himself of that which has been proved thoroughly efficacious.

With the foregoing brief description of the component materials of size we may now pass on to their blending. A blend is usually termed "a mixing." Its composition is dictated by the class of work for which it is intended to be used, and the more or less knowledge and judgment of the manufacturer or his manager. If an intelligent person connected with the business would undertake a careful and thorough study of this subject, it is our belief he would be well rewarded, as it is far from being exhausted. This certainly has never, to our knowledge, been done. It is a most important matter, and ought to be taken up in our best equipped technical schools by our practical weaving teachers who should work alongside and with chemical experts. There would then be something more reliable to guide one than the empirical conclusions that now serve the requirements of the trade.

In the early days of sizeing the materials were mixed by hand in pans, earthenware mugs, wooden tubs and sizeing troughs. As the materials seldom consisted of

more than a few pounds of flour with enough water to make a mixture of the consistency of cream, the task was simple and the labour not great.

In the second stage when sizeing developed into a separate business, mixing was still a manual operation, though conducted on a much larger scale. A number of hogsheads cut into two were adopted as holding more than the vessels previously in use. The custom of fermenting the flour magma, the blend of flour and water, was introduced, and these large tubs became convenient storage vessels. Their contents were systematically, at intervals, stirred up by a labourer who used a long pole. This task was not easy, and consequently was imperfectly performed. And the trade waited for an inventor to improve the method. In a while he came.

About 1856 Mr. James Eastwood, of Blackburn, invented and introduced to the trade the first mechanical size-mixing arrangement. It was a large churn-like tub, first conical then oval, fitted with a vertical shaft carrying arms or dashers by the revolution of which the size was agitated or mixed. This was driven by a horizontal shaft and bevel gearing fitted upon the top and connected by a strap with a shaft in the room. It was a great improvement upon the manual method.

But something else was required. The use of raw size, as the unboiled article is called, in the sizeing machine was the cause of a great deal of trouble, as it could neither be sufficiently boiled nor could any uniformity be preserved in the sizeing of the warps passed through it. To overcome this, a preliminary partial, or perfect boiling of the size was adopted, which was done by the injection of steam by means of a pipe into the mixer just described. This constituted another advance, and met with great favour from manufacturers. The sizeing tubs were, however, found to be inconveniently small, and a preference began to be expressed for a very perfect boil of the size before its introduction into the sizeing machine. In order

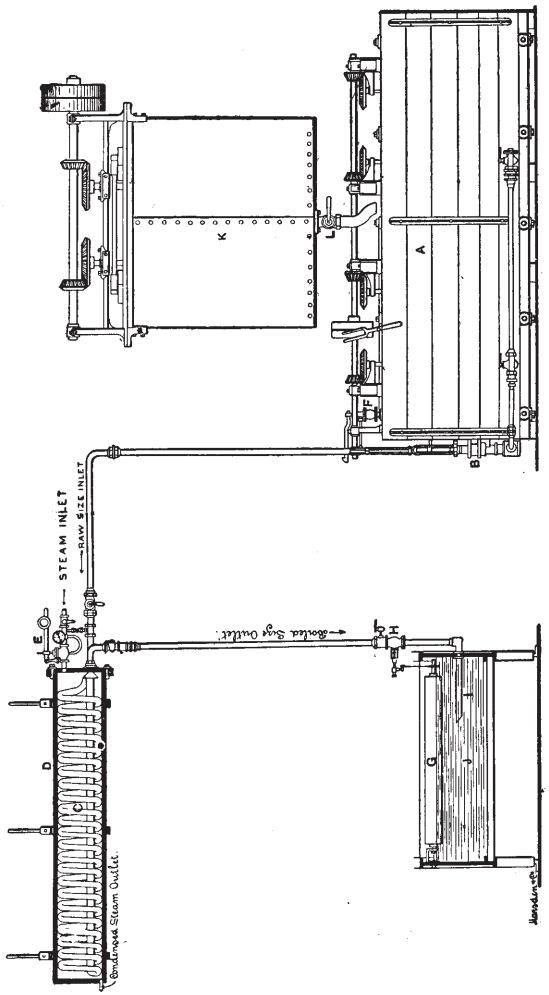

FIG. 213. MECHANICAL SIZE MIXER AND COIL BOILER.

to meet this requirement, the tub form was replaced by large square or oblong becks of great capacity fitted with several agitators. This gave an opportunity for obtaining more uniform results, as large mixings could be made at once, whilst it secured far more perfect fermentation where such was desired. But still the results were not everything that was desired. The boiling of large masses of size by the injection of steam meant a continuous introduction of additional water, derived from its condensation. How to keep this water out was the next problem to solve. Again Mr. Eastwood met the requirement of the case by devising a plan of forcing the size through a coiled copper tube, the coil being contained in a cast-iron tube forming a steam chamber which is kept heated with steam at a pressure of 12 lb., so as to boil the size as it passes through the coil. This with modifications and improvements in details is the system generally in use to-day.

The accompanying illustration, fig. 213, shows the details of the mechanical size mixer and boiler, as in use in most establishments to-day. In the beck, A, the size is mixed in the two compartments by means of the dashers, two in each, driven by the bevel gearing. It is divided into two equal compartments in order that one may be drawn upon whilst in the other a further supply is being prepared. There is a brass ram pump, B, connected with the two compartments in the manner shown, the piping being of copper, and the taps and fittings of brass, in order to prevent the rapid oxidation that would occur were these of iron. The size is drawn through these pipes from the cistern, A, and carried through the horizontal length of the tube to the left of the figure where it enters, and is forced, the coil being boiled on its passage, to the vertical outlet pipe, down which it descends to the size trough, J, of the sizeing machine. The coiled pipe is inserted into a cast-iron pipe, D, which forms a steam chamber. Into this steam is admitted, the pressure being regulated by the reducing valve and the steam gauge, E, so as to give

the requisite amount of boiling the size requires to suit the work in hand. The general working pressure is about 12 lb. per square inch. In order to regulate the supply automatically sent to and delivered by the coil, the pipe that conveys the size to the latter is provided with an overflow valve, F, which conveys any excess back to the compartment from which it is being drawn.

The flour, starch, or farina is prepared in the way shown in the beck, A, but the china clay, and the chemical ingredients need somewhat different treatment. They are therefore boiled together, but apart from the flour, etc., in the oval iron pan, K, which is fixed upon a stage above the beck, A. This pan is supplied with an open steam-pipe by which the contents are boiled. To secure perfect disintegration, the pan is furnished with two dashers which are driven in the same manner as the others. The mixture is drawn off into one or other of the compartments of the beck, A, according to requirement and at the proper time.

The size is also drawn from the coil automatically, according to the consumption upon the work. This is accomplished by means of the cylindrical copper float, G, which is connected with the feed tap, H, the combined action of the two regulating the quantity of size passing through the pipe, I, into the trough, J, exactly as it is taken up by the yarn passing through it.

This mechanical size mixer is a very effective machine. Like all the other machines we have had under consideration it has been of slow development, but now accomplishes everything that the manufacturer desires with a minimum of attention and a maximum of efficiency. It is not necessary to mix more size than the order in hand will take. This is only boiled and supplied to the sizeing machine exactly as it requires it. There is no fear of a short or excessive delivery. Every particle of the size must go through the boiling coil where it is uniformly boiled, it not being possible for any raw or half-boiled size

to get to the machine trough. It is installed in most of the weaving mills of Lancashire.

Sizeing varies according to the character of the cloths being manufactured. It may be roughly divided into four styles or kinds, namely, light, medium, heavy, and extra heavy.

Light sizeing includes all sizeing for weaving only; it is used for the better qualities of grey cottons, and for nearly all cloths that have to pass through subsequent processes, such as bleaching, dyeing, printing, and other methods of finishing. It would be a waste of material and labour, costing a considerable sum of money, to heavily size such fabrics as we have named, as in most cases the size would simply have to be washed out again. The percentage of size put upon the warp in light sizing ranges from about 10 to 25.

Medium sizeing is used in the manufacture of good and light classes of cloth usually exported in the unfinished or grey state, such as good shirtings, jaconets, mulls, and corresponding grades of bordered cloths. The percentage of size put upon the warp in these cases is from 25 to 50.

The next division is termed heavy sizeing, and the weight put into the warp is from 50 to 100 per cent. It is used in heavy, coarse fabrics, to give bulk and weight at little cost. Many of these goods are used for common linings, paddings, etc., and are as good for these purposes almost as if they were made of more costly material. The balance are the low qualities of grey cloths made for exportation. Enormous quantities are used for burial purposes in China and other eastern lands.

The last division is termed extra heavy, and includes all cases wherein the weight put upon the warp exceeds 100 per cent. This system is not in extensive use.

Of course in every case a more or less amount is rubbed off by the friction upon the warp in its passage through the healds and reed, and in the subsequent handling.

The amount is naturally greatest in the heaviest sized section.

We give a few recipes of size mixings to suit the varieties of cloths described. The mixings are large enough for average weaving establishments, as it is better to mix oftener than to run the risk of serious depreciation of the quality of the blend, owing to the origination and progress of chemical changes that might completely alter the nature of the mixing. The strength of size mixings is generally tested by the specific gravity which is ascertained by means of a hydrometer known by the name of Twaddell's hydrometer. This has a scale which is easily understood. When a mixing is thus tested, it is said to be "twaddelled." The degree indicated is given in figures with the letters Tw. following.

No. 1.—To give up to 25 per cent. on weight of warp:

Farina	400 lb.
Tallow	56 ,,
Wax	6 ,,

Chloride of zinc is unnecessary in the above.

No. 2.—The following is a good mixing for giving the same or a little more weight in cases where the yarns are lower in counts, and the cloth is wanted to have a bulky feel and to look full:

Wheat flour	600 lb.
China clay	200 ,,
Tallow.	15 ,,
Chloride of zinc	30 ,,
Aniline blue	½ oz.

No. 3.—The following mixing will yield from 50 to 100 per cent.:

Wheat flour	500 lb.
China clay	360 ,,
Tallow	140 ,,
Chloride of zinc	60 ,,
,, ,, magnesium	120 ,,
Aniline blue	½ oz.

The above will give a good feel and a full look to the cloth. It will easily yield 100 per cent. if desired, or any intermediate weight down to 50 per cent., according to the specific gravity at which it is used.

No. 4.—The following is also a mixing for coarse yarns, and will give 100 to 120 per cent:

Wheat-flour	400 lb.
China clay	500 ,,
Tallow	250 ,,
Glycerine	50 ,,
Magnesium chloride	200 ,,
Zinc	200 ,,
Aniline blue	1½ ozs.

In heavy and extra heavy sizeing, in order to be perfectly assured that mildew will not subsequently develop, mixings should always contain 10 per cent. of 102° Twaddell of pure zinc chloride to the gelatinous substances. When this proportion is present little fear need be entertained of bad results arising afterwards.

No. 5.—The following is a mixing to give about 50 per cent. on warp yarns up to about 34's:

Wheat-flower	500 lb.
China clay	300 ,,
Tallow	100 ,,
Chloride of zinc, 102° Twaddell	56 ,,
,, magnesium	30 ,,
Aniline blue	½ oz.

No. 6.—The next will give 100 per cent.:

Wheat-flour	560 lb.
China clay	675 „
Tallow	140 „
Chloride of magnesium . .	80 „
„ zinc . . .	60 „
Aniline blue . . .	1½ ozs.

No. 7.—This is a mixing for "extra heavy" sizeing:

Wheat-flour	560 lb.
China clay	750 „
Tallow	150 „
Oleine	65 „
Chloride of magnesium . .	150 „
„ zinc . . .	120 „
Aniline blue	2 ozs.

No. 8.—In the following Farina is the principal ingredient:

Farina	700 lb.
Sago	250 „
Tallow	100 „

No. 9.—Another of similar description, which will give 25 per cent. weight on warp:

Farina	500 lb.
Tallow	20 „

The above recipes will probably meet all requirements.

Size mixings, however, are countless, as almost every sizer has some particular recipe of his own which he esteems above all others. Should any of the above be adopted, each operator will probably add some ingredient in which he has abundant, if not superabundant faith.

In the use of the chemical ingredients, and to facilitate the change from gallons to pounds, or *vice versâ*, which will enable them to be measured, we give the following table:

1 gal. chloride of magnesium,	56° Tw.,	weighs	13 lb.
„ „ zinc,	96° Tw.	„	15 „
„ pure water,		„	10 „

The China clay should always be well boiled. In making the mixing the zinc and magnesium chlorides are sometimes boiled with the China clay, but this is a mistaken procedure, and does no good whatever. They should always be added to the raw flour and water when they commence their action upon it. It should also be borne in mind that alkalis and chlorides are antagonistic or repellent bodies, and will not work together, and as the chlorides are indispensable, the alkalis, whether in the form of soda or soap, must be kept out.

Formerly flour was put to steep and ferment for from six to twelve weeks. This was for the purpose of breaking it up into the finest particles and to get rid of the most easily fermentable ingredients, and thus reduce the risk of mildew. But the general adoption of the new method of grinding by means of rollers, which reduces the flour to a much finer condition than the old system, a steeping of three weeks answers all requirements. The beck in which the dry flour is put to the water will store it until it is wanted. From this it is transferred by means of pipes and pumps to the final preparation cistern, which, as shown previously, has two compartments: one in use, and the other in preparation. From these, after the necessary treatment as previously described, the size is drawn and passed through the coiled boiler to the machine. When the weather becomes more than ordinarily dry, it may be desirable to add a little more chloride of magnesia which is the best ingredient for attracting and retaining moisture. The sizeing recipes we

have given above relate entirely to the sizeing of warps in the grey state.

The following mixings are in use in the sizeing of bleached and dyed yarns in the hank and ball warp form.

No. 1.

Wheat flour	280 lb.
Soap	10 „
Tallow	10 „

This can be used at a strength of 14° to 16° Tw.

No. 2.

Sago flour	180 lb.
Water	36 gals.
Coconut oil	$2\frac{1}{4}$ lb.

No. 3.

Farina	70 lbs.
Sago	20 „
Soap	8 „
Tallow	2 „

To be boiled up with water to 15° Tw. These mixings give a light sizeing of a pure quality.

The following is a recipe for a heavy sizeing blend:

Wheat flour (fermented)	230 lb.
China clay	440 „
Sago	50 „
Soap	50 „
Chloride of zinc	50 „

Make up to a strength of about 42° Tw.

The following is another:

Wheat flour	280 lb.
China clay	560 „
Tallow	100 „
Chloride of magnesium	260 „
Chloride of zinc	28 „

Make up with water to 45° Tw. If 8 lb. of soda be added, it is held to facilitate the mixing of the size, though we hold this to be doubtful.

In sizeing bleached or coloured warps a rather stronger size is used: that is, one Twaddling heavier.

Heavy sizeing often dulls the colours of dyed yarns making them look milky. It is desirable to avoid this, which can be done by adding to the mixing a little dye-stuff, the so-called direct or substantive dyes lending themselves best to this purpose. Of course, a colour appropriate to that of the yarns being sized must be used.

The following will be suitable:

For Pinks:	Erika or Titan pink 3 B.
„ Scarlets:	Diamine Scarlet 3 B, or
	Titan „ C.
„ Dark Reds:	Titan red 6 B, or
	Benzo-purpurine 6 B.
„ Blues:	Titan blue 3 B.
	Benzo-azurine.
	Benzo-blue BX.
	Diamine blue 2 B.
„ Yellows:	Titan yellow R, or
	Oxyphenine.
„ Oranges:	Titan orange, or
	Congo „ R.
„ Browns:	Cotton brown, or
	Diamine „

For Greens:	Diamine green B, or a mixture of a yellow and blue.
„ Blacks:	Diamine jet black S S, or Direct deep black T.

These dyes fix themselves readily upon the yarn and give fairly fast colours. They are particularly useful for this work.

In making blends of size, of course water is an indispensable element. There is no rule by which the quantity can be stated beyond this, that it may generally be added until the mixing becomes of the consistency of thick cream. It will then need thinning down to the state in which it will give the required weight upon the warp. The proper degree should be ascertained by the instrument usually termed "a Twaddle." Roughly speaking, for the low and medium counts of yarns, which are those usually sized from the lightest to the heaviest degree the following will give a guide:

	per cent.	per cent.	per cent.
Yarns, 16/36	25/50	50/100	100/200
Should Twaddle about .	15	25	40

Intermediate figures from these can easily be obtained. The best water to use for mixing purposes is that from condensed steam.

In dealing with size it is important to bear in mind that the injection of steam into it means the introduction of additional water, and consequencely a weakening of the mixing. If compensation be not made a considerable diminution of the percentage of size put upon the warp will probably ensue. Neither should it be forgotten that if the sizeing becks in which the size is boiled, or the sizeing machines served with steam for boiling in the trough

be located a considerable distance from the boilers, there will be a much greater condensation of steam, and, consequently, they will receive a much larger proportion of water than if they were near to the boilers serving them. As a matter of economy, therefore, the sizeing plant and machinery should be placed as near to the boilers from which they will be served with steam as possible.

CHAPTER XV.

Hints on Management.

A good practical or theoretical knowledge of the trade by principals a requirement of success.—Checks carelessness and promotes efficiency amongst subordinates.—Best locations and sites for weaving mills.—Temptations to indiscipline.—Managerial oversight.—Qualities of a good manager.—Foremen.—The winding master and his functions.—Winding.—Warping.—Uniform weights of sets of beams and how to get them.—The sizeing room and its supervision.—Details.—Tacklers and their duties.—Should possess technical knowledge.—A good tackler will get good weavers.—A good class of weavers a necessity.—Good discipline in the weaving shed conducive to success.—The Warehouse an important department.—The piece book and the "tally boards;" checking errors.—Cloth-looking; various methods.—Defective cloth.—The onerous duties and responsibilities of a cloth-looker; qualities of a good one; necessity of supporting his authority.—Hooking or plaiting and making-up.—Overworking the warehouse staff, bad policy; mill and Manchester cloth-lookers.—Disadvantages of buying poor yarns.—Isolated strikes.—Immoral conduct.—The Factory Acts.—Mill managers should be acquainted with them.—Why employers are prosecuted for the offences of operatives.—A means of defence.—Clause 87 of the Act of 1878.—The "Steaming Act."—Atmospheric humidity and its variations; its influence upon cotton weaving.—The suspension of water in the atmosphere at various temperatures.—Means of measuring it.—Humidity schedule of the Cotton Cloth Factories Act.—Care required to avoid penalties.

IN face of the competition and frequent depressions occurring in the cotton trade it is incumbent upon those engaged therein to conduct it with care and economy in order to assure success. This, however, can only be accomplished in the most perfect manner where the principal or principals are thoroughly conversant with the

practical details of the work of each department, which will enable them to trace the results of neglect, carelessness, or bad workmanship directly to those who are responsible. More than this is also required: the principal, or one of them where there are more than one, should be a good business man in order that he may take safe charge of the commercial portion. This is quite as important as the practical part, because incompetence in either division will often neutralize the best of skill in the other. It is only rarely, however, that these qualities are combined in one person, and even where this is the case it is impossible to bring all into full play. One portion of the duty must be delegated to a second person, whose interest, if he is not a partner, is necessarily less than that of the principal. A firm consisting of the partnership of two persons, one of whom has had a thorough practical training, and the other an equally good commercial education, offers the best combination for insuring success, assuming that other requisites, such as character, etc., are what they ought to be.

As, however, it is not always that a practical knowledge of the trade can be acquired by persons desirous of engaging in it, the best thing in these circumstances is to get a good theoretical acquaintance with the different departments, and the nature of the processes carried on in each. This will tend to promote efficiency, as it will enable a master to check the carelessness of servants who neglect their duty, presuming that no one will be able to find out the source of the mischief. It is doubly necessary in times like the present, when profits in most branches of manufacturing have been much reduced, that the most careful supervision should be exercised, and that the machinery should be put into the best condition its state will allow, in order that the least possible waste may be made and the best work brought out; in other words, that the highest quality may be produced at the least cost. In order to aid in a small degree those who have not had the advantage of a practical training, it is proposed in this

chapter to offer a few hints that may be found of use in the management of weaving establishments.

Weaving mills are best located in the weaving districts. In making election of a particular place, regard should be had to the class of goods it is intended to manufacture. When the locality has been decided upon, great care should be exercised in selecting the site, which should be amongst the best class of workpeople in the place, and in a neighbourhood which has few, or better still, no drink-selling places in close proximity. These very often prove a great difficulty in the management of a mill, and greater in a weaving than in a spinning mill, because of the larger number of people usually employed in the former. Amongst the three or four hundred people thus gathered together, it often happens that there will be a small percentage addicted to drinking. These will take advantage of every little accidental stoppage to resort to the drink-shop, from which it is almost impossible to drag them until they have rendered themselves unfit for work for that and, perhaps, several following days. Wanting these trifling chances of self-indulgence, they will frequently make others, and be found stopping away to indulge in their favourite vice; and the manager and overlookers will, perhaps, at a busy moment find a dozen or so of looms without weavers, when the fullest production from every one is required, in order that contracts may be completed in time. But this is not the only, and hardly the most serious evil, that results from this bad habit. Whenever the weavers in a shed can see looms standing for want of weavers to superintend them, discipline becomes relaxed; carelessness and idleness take the places of care and steady industry; and a worse quality of work, and less of it, is the consequence. It is absolutely requisite that any infractions of discipline of this kind should be punished by instant dismissal. The saying that "a sickly sheep will taint the flock" was never more true than in this connection. Unless the manager has to lose all control of the establishment, this

evil must be dealt with in the firmest and sternest manner. It is pleasing to believe, however, that it is a diminishing one.

In the event of the owners not taking charge of the internal management, it will be found desirable to appoint a manager. The oversight of a manager is a necessity in a cotton manufacturing establishment, and in some much more so than in others. The one making one or two standard fabrics from year end to year end needs comparatively little, whilst another, making it may be miscellaneous goods, will at times have from 20 to 200 sorts going at once, all of which must be looked after in every detail in order to prevent matters going wrong. Thus the one position involves a great deal more labour and responsibility than the other, and will require a manager with a great aptitude for dealing with details.

The first requisite for a good manager is a thorough mastery of details. It would be best that he should be practically conversant with the work of every process. This, however, is difficult to obtain. The next best thing is that he should have been trained for the post: that is, that he should have entered the mill and have undertaken a course of study of every process, with the view of acquiring as thorough a knowledge of the principles and best practice of each that should be possible by an intelligent young man in the course of two or three years. Besides making himself familiar with the details of each process, he should constantly carry in his mind, and be ready to put to himself the question: Can as good, or better, results of the process before him be attained more economically? Is there anything in the organization of this department that can be improved? A critical examination will result from the putting of these questions, and it will be astonishing how many weak spots can be found.

A student for a managership will go through his study of the processes all right, but will necessarily have to come

out imperfectly trained in one respect: he will not have been entrusted with the management of the workpeople. This he can only acquire in the actual work of his vocation. He may, however, whilst acquiring the preliminaries, keep his eyes observantly open to the doings of the workpeople and mentally note that which is right and wrong. He will thus train his observation in a valuable manner for the performance of his future duties, and will find the accomplishment almost invaluable when called upon to put it into practice.

A good manager will take care to obtain a good staff of foremen. These in a weaving firm will consist of sub-managers, if the firm is a large one having several mills, winding and warping masters who take charge of the winding and warping department; foreman sizer, where there are a number; foreman drawer, or twister, when the mill is large; tacklers, or tuners, as they are in some places called, who have charge of the weavers; and, lastly, the cloth-lookers.

The function of the winding master is to take the general supervision of the winding and warping room. He engages and dismisses the operatives; instructs them as to the counts of yarn they have to work; sees that the winding is done upon the proper colour of bobbins, and that these are not mixed; takes care that the winders mark their bobbins, for the purpose of subsequent identification if required; checks the making of excessive waste and the over filling of bobbins; sees that the workers are properly supplied with yarn without favour or partiality as to either quantity or quality; takes care that no undue accumulation of yarn is made upon any of the "sides" as the winders' portions of the machines are termed; and maintains strict discipline as to the proper attendance and general behaviour of the workers when at work. Preferably the winding master should be an elderly married man of high moral principle, even tempered, and very firm, as the good management of a large number of

females needs both skill, prudence, and great firmness. Other remarks equally suitable to this place will be found in the preceding chapter.

The warping or beaming, section of his charge, also requires care in the details of the work. The main requisite is to see that the proper number and lengths of back beams are made to complete the orders received by him. There is little or no trouble in doing this when standard cloths of one count of yarn are made from one year end to another. It is different, however, where every set of beams vary in either counts or lengths. It is then there is required the exercise of the greatest care to avoid waste, or loss and annoyance by spoiling the orders through deficiencies, or overmaking them and having job lots left.

It should be the winding master's duty to make his sets of beams for the sizer of uniform weight, and these as near as possible to the calculated weight required that with the addition of the size and the proper counts of weft in weaving will best give the contract weight of the cloth. If this be neglected here it cannot afterwards be remedied. It has already been told how this should be done, namely, by taring every empty beam, painting the weight on the flanges, weighing each full beam, chalking the weight above the tare and thus getting the net weight. Should these vary, the proper set weight should be got from an assortment that will make it up correctly. Light sets and heavy sets should never be made, as these defects will be exaggerated in the sizeing process, and all sorts of piece weights come from them. The gross, tare, and net weight of every set of back beams sent to the sizeing machine should be recorded, and preserved for reference in the event of the weights coming wrong from the looms. This will permit of accurate investigations being made into the quality of the yarn, and will reveal negligence in sizeing. Yarns differ in their power of absorbing size, especially owing to the variation of twist in them. A strongly

twisted yarn is necessarily more consolidated than one containing less twist. The first absorbs less size than the latter, though the counts may be the same. It is desirable to obtain yarns to work together that are uniform in their amount of twist. These points are worth a manager's careful attention.

The sizeing room on many accounts demands a large share of the attention of the foreman sizer, if there be one, or if not, of the manager. Upon the proper and continuous working of the sizeing machines depends the regular supply of warps for the looms. Care must therefore be taken that there is always a set of beams ready for the machine immediately the one in work is finished. Precedence must be given to the most urgent orders, so as to avoid the risk of complaints and cancellings of orders on account of non-fulfilment within the stipulated time. If the looms get filled up with orders that are not urgent they cannot conveniently be emptied in order to put in work that should have gone in first. The manager must therefore carefully measure the productive capacity of his looms upon and by his orders in hand, and on that basis give precedence in the sizeing room to the orders that will be required to be delivered first. This is a point that deserves his first attention.

With careful, steady, sober, and efficient men the sizeing room ought not to give the manager much trouble or care; but without such men it will give him a great deal. A drunken workman in this room may easily do a vast amount of injury, and inflict a large loss upon the employer. Such a man is best got rid of in order to avoid such contingencies. Every sizer should be instructed to report to the manager irregular or bad work that involves inferior work passing from him to the weaving shed, or that results in loss of yarn.

In other respects the sizeing room will not demand much further notice. The chief points to assure are a sufficient supply of steam for the proper boiling of the size

in the trough; and in the cylinders to thoroughly dry the yarn in its passage over them. The machines should be kept clean and well lubricated in their bearings, the measuring arrangements properly adjusted, correct change wheels used, and the beam presser kept in accurate working order. No loom beams should be put into the machine with loose or crooked flanges. In doffing the slow motion should always be used in order to prevent the baking of the size upon that portion of the warp upon the copper rollers. In lengthened stoppages the yarn should always be brought out of the size trough by raising the immersion roller, in order that no baking of the size may take place upon it. The rollers and the size trough should be kept perfectly clean, and no old size should be allowed to cake or accumulate upon any part. A manager should accustom himself to see at a glance when any of these things are neglected, and insist upon prompt attention to, and the maintenance of proper order in every case.

The next point of importance is the engagement of a good class of overlookers—tacklers or tuners as they are usually called—to take charge of the looms and the weavers. The function of the tackler is to keep the looms of which he has the oversight in good working order; to supply and "gate" new warps in them when the preceding ones have been woven through; to give the weavers all necessary information regarding weft, headings, middlings, or any other detail needed for the proper performance of the work. The tackler is charged with the oversight of a given number of looms, termed a set, the number varying in them according to the amount of supervision and attention the class of work may require from him. In the Burnley district of East Lancashire, where light printing cloths are made, a set may consist of about 120 looms, this being about the maximum number. In places where the looms become more and more complex in construction, and require more care, as in the manufacture of fancy fabrics, the number of looms in a set diminish until they

get down to about fifty or sixty, which will be about the minimum. Tacklers are paid by a commission upon the earnings of their weavers of so much in the £, and hence is termed poundage. This varies a little, according to the character of the work and the number of looms in a set. This system of payment ensures stricter supervision over and discipline amongst the weavers, and so is conducive to both quantity and quality of production, and consequently to the economical working of an establishment.

Tacklers are made from weavers. Of course they are always men, the nature of the work required being unsuitable in many respects for women. The position is both financially and socially a promotion from the post of weaver. The qualities required in a tackler are: a thorough knowledge of the principles and construction of looms, and of the weaves that can be executed upon them, especially of those of which he ventures to assume the oversight; mechanical ability, enabling him to see at a glance when, how, and at what point a loom has gone wrong, and to set it right again. He will need at times to instruct the less competent weavers in some one or other of the details of their art of which they may be ignorant; physical strength is a valuable quality, as it is required in carrying the heavy beams to the looms, and is occasionally useful in exigencies that may arise in connection with the maintenance of discipline; and, lastly, moral character, and skill in the management of workpeople, are also valuable traits in a good tackler. In order that a tackler may do the best both for himself and his employer he is generally entrusted with the power to engage and discharge the weavers over whom he is placed. It is therefore his ambition and interest to get the best set of weavers he can obtain.

But the main requisite in manufacturing, after the best machinery, is a good class of weavers. Without these, even good machinery and the best preparation will go for little. Rigid discipline is necessary to train operatives to

a good standard, and to keep them at that position, as amongst several hundreds, changes are constantly taking place. But it can be done where thorough harmony exists between the managing and the warehouse departments. Sometimes opposition arises between these, the former desiring to secure a large production, regardless of quality; the latter checking this, owing to the necessity of maintaining the quality. The liability to this conflict is very difficult to prevent, and to do this in the smaller establishments the functions of manager and clothlooker are often combined in one person.

A manager, who is a good disciplinarian, will see that his overlookers are at the mill at the proper time in the morning, and at each recommencement at meal hours, in order that they in turn may similarly influence their subordinate weavers. Steady attention during working hours to their looms should be required from the weavers, and at the proper time to cleaning and oiling their machinery. All this can be secured by attention on the part of the overlookers, and where it is fully obtained the employer will be gratified at the quantity and quality of the production, and the economy with which it is accompanied. The operatives will be pleased with the amount of their earnings, and the establishment will gain character amongst those not connected with it, which will always ensure a good supply of hands. And better than all, the quality of the work produced will secure it repute in the market, by which the best prices will be ensured.

The warehouse is an exceedingly important department of a weaving mill. It is the room in which the production of the looms is received from the weavers, inspected, assorted, made up, and stored until despatched to the agent who sells the production, or to the merchant who may have purchased it, if it should be delivered direct. This is in the case where, as is usual in the great cotton manufacturing establishments of East Lancashire, the handling of the article ceases with the sale of the grey cloth. In the few

instances in which the manufacturer strictly so-called combines also the one of merchant, before leaving his possession the cloth undergoes what are technically called the finishing processes. These may be either bleaching, dyeing, or printing, and the routine is slightly varied according to the circumstances of the case. It may be, as in some instances, that the goods are despatched from the mills by the manufacturer to some finisher who treats them according to instructions, and then delivers them back to the manufacturer's warehouse, say in Manchester, whence they are sold in large or small lots, as required by customers. Probably, however, more than seventy-five per cent. of the production is disposed of in the "grey," as the unbleached and undyed stage of the cotton cloth is termed. It is, therefore, this phase of the business to which these and the following remarks are intended to apply.

Nearly all weaving is performed on what is called piece-work terms: that is, for a stipulated quantity and quality a certain sum is paid. These quantities are called "pieces" or "cuts," the former because they are pieces or portions of a warp, and the latter because they are such lengths as when woven may be properly cut from the warp in the loom. The manufacturer sells in the market, say 5,000 pieces of shirtings, jaconets, or mulls, and gives his manager orders to make them accordingly. In the process of sizeing the warps are marked in the proper lengths, and wound upon the loom beam until the latter is filled. An automatic indicator registers the number of pieces that are put upon each beam, and a ticket is issued therewith giving order, number, counts of yarns, quantity of ends in the warp, number of pieces contained upon the beam, the number of picks that have to be put into it, and the counts of the weft yarn with which it is to be woven. This information is an instruction to both tackler and weaver. The latter, when he has woven his first piece, takes the warp ticket with it to the warehouse, where he has the details entered

into the warehouse piece-book, and also upon a check or tallyboard, on which a receipt is given him for all the pieces he delivers into the warehouse. The proper keeping of this book entails considerable care, because disputes are liable to arise between the person having charge of it and weavers, who will sometimes declare that they have not been credited with all the pieces that they have woven. To the credit of the operative weavers it may be said that very few false allegations of this kind are made. When a dispute arises, the piece-book is the safest guide, as it may be assumed that it is less liable to be tampered with than are the check-boards of the weaver. The truth, however, can be almost with certainty ascertained from two sources: the first being the warehouse stock of the particular kind of cloth in dispute, which ought to be taken weekly after all the pieces at the close of the week have been made up; and the second by waiting until the warp is finished, by which it will be seen whether it closes with what should be the last piece. This, however, is not always satisfactory, as it may leave the matter in dispute two or three weeks, by which the weaver would be kept out of his or her money, or on the other hand, if a dishonest claim had been paid, it would probably be found that the weaver had left the establishment.

Cloth-looking is the careful examination of the cloth as it comes from the looms, its purpose being to keep up the standard of quality to the necessary degree of excellence, to secure for the production of the mill a good name in the market. The person to whom this function is entrusted is called the cloth-looker, and his duty is to carefully examine every piece to see that it is properly made, and free from faults and blemishes of every kind. There are two or three methods of performing this work, but substantially there is not much difference in the results, if the work in each case be conscientiously performed. The first may be said to be that of "flewing" it, which is probably the oldest form, and a survival from the days of handloom

weaving. When the weaver has completed a piece of cloth, it is "pulled out" from the cloth beam of the loom, being folded in "flews" or layers upon the slay cap of the loom. Probably the word "flew" is derived from turning the folds over in a manner that might be described as flying them; or it may be a corruption of the word "fold." These folds are of course made from the length of the fabric, and are usually from about ten to fifteen inches broad. When the piece is all drawn off the cloth beam, it is doubled upon itself in the direction of the width, and in this form delivered into the warehouse. The clerk who has charge of the piece-book pencils upon it the number of the loom from which it has come, in order that if required the weaver may be identified. The cloth-looker takes up his position in front of a long bench of about a yard and a half wide, and at a point with a window in front of him to afford plenty of light. Taking up the piece to be examined, he first weighs it, which shows him whether it is substantially right in the length, and made of correct yarns, the right weight being known. Should it vary from the requirement in this respect, and yet be correctly made from the proper yarn, and the length also be right, it may require that the cloth-looker to direct that heavier or lighter weft be used, if the conditions of the order render that necessary. Where the requirement is simply a guarantee that certain counts of yarn shall be used, the introduction of heavier weft may not be requisite. The variability in the weight of the cloth mainly arises from the varying humidity of the atmosphere, the weight being greatest in damp and rainy weather, and least in the cold dry frosty weather of winter, the dry periods of spring when east winds prevail, and the hot and dry weather of summer. Should the piece, however, be all right in this respect, the cloth-looker throws open the fold in its width, and arranging it in front of himself, and in a line diagonal to the window, rapidly and skilfully turns over the flews,

or folds, of the cloth, carefully inspecting it as he proceeds. Any fault or departure from the even texture is easily observed. Having thus inspected the piece halfway across its width, for its whole length he throws it over, by which the other side is brought to his hand, when he rapidly repeats the process. Should any fault be discovered in the weaving, the piece is laid aside, and the attention of the weaver called to it, and a reprimand given, or a small abatement made such as may meet the necessities of the case.

In the second method the cloth-looker has his bench painted black in front of him, and placing the pieces at the top, takes hold of the end, and draws it evenly over the dark surface, which shows up every fault with great distinctness. This, however, is a very laborious method for the cloth-looker, and it has been obviated by an arrangement in which a pair of rollers draw down the cloth, these being actuated by a small band brought from one of the shafts in another part of the works. This is, perhaps, the best plan of examining cloth, provided proper attention is given to it when it is passing over the board.

The points to which cloth-lookers are required chiefly to direct their attention are to see that the weights, lengths, and widths of the cloths are correct; that they are free from weavers' defects or faults, which may be enumerated as being thick and thin places, made chiefly in stopping and starting the looms; broken warp threads not being pieced with sufficient promptitude; "floats" or scobs, caused by a broken warp thread getting entangled in the shed, and preventing the warp from "clothing" as the weaving proceeds, which results in a fault little better than a hole. These defects are incident to weaving, and require carefulness and strict attention on the part of the weaver to keep them out. For all defects clearly due to his negligence the weaver ought to be held directly responsible. There is another class of faults which may and mostly do arise from the loom being out of order: bad

selvages, uneven cloth, thick, and thin places. The weaver is properly held to be responsible for these until the attention of the overlooker has been called to the faulty condition of the loom. They are sometimes difficult to cure, but the responsibility of the weaver is not discharged by any failure of the overlooker to mend the matter, as the loom ought to be stopped until it is made right, and the overlooker held to the task until the defect is cured.

The position of cloth-looker is the most onerous and difficult to maintain of any in a mill. His hand is literally against every man, and woman too, and theirs against him. In many cases, in fact probably more than half, he is directly responsible only to his employer, not being subordinate to the manager. This arises to a certain extent from the necessity of placing him above the risk of any pressure being brought to bear upon him to make him swerve from what he conceives to be necessary, from his point of view, to secure and maintain the interests of his employer. The interests of the overlookers and managers of mills, the former especially, being paid a commission upon the earnings of the weavers, are to some extent in conflict with the duties of the cloth-looker, as they are more anxious to secure a large production than careful of the quality, which would interfere with the realization of the former object. The employer should be exceedingly careful in the selection of an intelligent and equitably minded man for the post of cloth-looker. He should be skilful, prudent, cool in temper, resolute in the assertion and maintenance of his decisions, of strict integrity and high moral principle. He should have nothing of a weak or revengeful disposition within him, and should never display either favour or fear in his dealings with the weavers. A conscientious man having these traits of character placed in this post will be found to be almost invaluable to an employer. The principal of the establishment should always energetically support the authority and moral influence of the cloth-looker; even if

he should happen to make a mistake, a semblance of maintaining the position should be kept up, whilst a real retreat should be made from the untenable attitude, which can be effected by pointing out to the cloth-looker in a private interview the mistake he may have made. This support should be given as a matter of policy, because the mass of weavers cannot always discriminate between the merits or demerits of the dispute, and would look upon the humiliation of their common enemy as a victory for themselves, that if followed up and repeated would be an advantage to all.

After the cloth has been examined, it is hooked up on a frame, or plaited in a machine generally in yard folds, is folded into smaller compass, and five, ten, or more pieces made into one bundle, tied up, and stored ready for despatch to its destination. This part calls for little remark beyond the observation that the work should be neatly and tidily performed, and the selvages of the cloth carefully brushed in, or to take off the loose threads of weft; and every other means should be taken to give the goods a smart, clean-looking appearance, in order that they may make a good impression when delivered.

Too often the warehouse staff is overworked. Many employers seem to think it good policy to save every penny they can in this department, and therefore overwork both cloth-lookers, hookers, and makers-up. This is a bad policy, and is sure to entail much greater loss in another direction. The cloth-looker cannot do his duty properly, and faults in the cloth must frequently escape his notice. This can never occur without the knowledge of the weaver who has sent in the bad work. When they once discover that bad work has a chance of escaping detection, it is always a strong temptation to them to "try it on," by which the whole tone of the establishment is speedily lowered. Further, when the cloth is sent to the merchant in Manchester, it is nearly always carefully examined by cloth-lookers who have plenty of time in

which to do their work, but in most cases no practical knowledge of the weaving processes; and should the delivery in any sense present an untidy appearance, it is prejudiced in their eyes, and the actual defects are multiplied in number and magnified in size by their ignorance. Had the delivery been made up and smartly finished with the loose threads carefully brushed away, the chances would have been in favour of their passing without complaint or risk of rejection. A staff of warehouse hands sufficient to properly perform the work, it may be affirmed with perfect confidence, will always be not only the most economical but also far more profitable than one which is insufficient and overworked.

The vicious practice of buying low-priced yarns because they are apparently cheap is strongly to be reprobated. During long observation, the writer has never seen it result in permanent benefit. Good weavers will not struggle with bad yarns, because they increase their work and diminish their earnings. They will take the first opportunity of transferring their services to neighbouring establishments the owners of which have a more enlightened conception of their interests than to pursue such a policy. The employer in the former instance is soon left with a class of weavers who cannot even make good work out of good stuff, let alone out of the inferior material with which he supplies them. The consequence is that the reputation of the firm rapidly declines in the market, the production of the establishment fetches a lower price, losses are frequently made upon rejected or cancelled orders, and too often the end thereof is bankruptcy and ruin. The best advice that can be given regarding buying yarns is: aim to procure the highest quality that the circumstances require, and never descend below a good average. A policy of this kind will secure for a mill good weavers, a large production, a high quality of cloth, and the best prices of the market, all of which it will be admitted are highly desirable.

Isolated strikes were formerly a great trouble in the management of a mill. These had their origin very frequently owing to complaints as to the quality of the material supplied to the winding or weaving department. Bad twist or warp yarn might produce a strike amongst either the winders, warpers, or weavers; or bad weft amongst the latter. Owing, however, to the great improvements that have taken place in the spinning department of the trade in which these faults nearly always originated, they have become almost obsolete. The best way to avoid these is for the yarn buyer never to buy "cheap lots" unless guaranteed to be right in quality, so that if they fail in that essential point they may be returned without difficulty.

In a large establishment containing, perhaps, several hundred workpeople of both sexes, it sometimes happens that improprieties of a serious kind occur between the foremen and female *employées*. The master of the establishment should have a quick eye and ear for the detection of these matters, because whenever they occur he may depend upon it they will involve a great sacrifice of his interests. Favouritism will be shown, bad work will be hidden or condoned, and insufficient quantities will be accepted without rebuke. Far graver mischiefs than these also occasionally result. It is far from being advocated here that employers or managers should take cognizance of what occurs outside the walls of the mill, unless such acts from their character lead to disorganization or serious relaxation of discipline within, which may easily and does often occur. This should immediately be repressed, and with a very stern hand, as the bad consequences are as great as in the demoralization caused by cases of drunkenness.

There is one aspect of mill management that cannot properly be overlooked. This is the subjection of spinning and weaving mills to the Factory Acts, but especially the latter, for the control of which some special legislation

has in addition been passed. We refer to the Cotton Cloth Factories Act. Taking Factory legislation altogether an important chapter might be written upon how best to conform to or deal with its requirements. But space precludes more than a brief reference.

The manager of a mill ought to make himself acquainted to a reasonable extent with the requirements of the law, and in order to do this should procure a small treatise termed, "The Factory Acts," by Mr. Alexander Redgrave, late Chief Inspector of Factories. This should be carefully studied. From it an intelligent manager will easily learn his obligations, responsibilities, and rights. The latter are more considerable than are generally supposed, and if insisted upon will preserve him from much annoyance. Unfortunately our factory laws have received their colouring from the traditions of the evil days of factory life in the early part of the century. Throughout them it is assumed that the employer is the author of all their infractions, and he is accordingly mulcted on every opportunity. This assumption, whatever it might have been in the early times referred to, is not correct to-day. But acting upon it, and further influenced by a second reason, the Home Office always directs the prosecution of the employer, even when it is as clear as any object seen in a summer day that the offender is one of the operatives, and that the law has been broken in spite of instruction to the contrary. This second reason is not often suspected: Her Majesty's Treasury object to provide the means for insuring the observance of the law, practically declaring that prosecutions of offenders must pay their own way, and not be a burden upon the State. The result is that the inspectors, whenever they detect operatives breaking the law, take action against their employers, because in the almost certain event of a conviction following they are sure of getting their costs. Experience has shown them that if they take the real offender, though they may get a conviction, getting the costs is another matter altogether.

Not long ago, in a case which came closely under the notice of the writer, an inspector prosecuted an employer and lost the case, yet wanted his costs from the person who was proved not to have been the offender. He said, "The Treasury would want them," and thus let the cat out of the bag. Treatment of this kind is iniquitous, and every person entrusted with the management of a mill subject to the Factory Acts, should defend himself from it. There is a provision in the Act itself enabling him to do it. It is Clause 87 of the Factory and Workshops Act, 1878. For the benefit of managers who are often unfairly harassed by these prosecutions, the clause is here transcribed:

"87. Where the occupier of a factory or workshop is charged with an offence against this Act he shall be entitled, upon information duly laid by him, to have any other person whom he charges as the actual offender, brought before the court at the time appointed for hearing the charge; and if after the commission of the offence has been proved, the occupier of the factory or workshop proves to the satisfaction of the court that he had used due diligence to enforce the execution of the Act, and that the said other person had committed the offence in question without his knowledge, consent, or connivance, the said other person shall be summarily convicted of such offence, and the occupier shall be exempt from any fine."

It was by availing himself of this defensive clause that the gentleman referred to above succeeded in putting the burden upon the shoulders where the inspector himself ought to have put it in the first instance. A second paragraph in Clause 87 enables the inspector, when it has been made to appear to his "satisfaction" that the employer is not the offender, he may proceed against the person by whom the law has been broken. For the reason above stated it is always a very difficult if not hopeless task to make it appear "to his satisfaction" that anybody but the employer has committed the offence. It

is probably within bounds to say that eighty-five per cent. of prosecutions by inspectors are for breaches of the law with which employers have had nothing whatever to do. It is equally safe to say that not twenty-five per cent. of the magistrates, nor fifty per cent. of their advising clerks, who adjudicate upon these offences, are aware of the existence of the clause we have quoted. It is here placed in the hands of managers and responsible persons, who may use it to ward off unjust prosecutions.

The offences which operatives may commit against the factory laws are almost innumerable, but the solitary defence employers have is the one quoted. Passing to the comparatively modern aspect of these Acts, a recent extension must be referred to. This piece of legislation is termed the "Cotton Cloth Factories Act," 1889, and applies to cotton weaving only. It is ordinarily called "The Steaming Act." It is to be regretted that the trade brought its provisions and penalties upon themselves by the abuse, on the part of a number of employers, of a good principle—that of increasing the humidity of the atmosphere of their weaving sheds by the injection of steam. The operatives protested against the abuse of this, and the result was the Act named.

A very brief elucidation of its principles must suffice. The atmosphere at all times holds in suspension a quantity of water in the form of vapour. This varies with times and seasons. It is a fact known to every cotton spinner and manufacturer that cotton works best and makes least waste in a humid atmosphere, and worst in a relatively dry one, such as occurs in the heats of summer, the east winds of spring, and the dry frosts of winter. In all these conditions the introduction of water by which the atmospheric humidity was increased was found to be beneficial. This led to the discovery that the atmosphere would absorb moisture up to the point of saturation, or the point when rain begins to fall, and that if filled nearly to this state a greater weight of cloth could be obtained from a

certain amount of material than was the case in average conditions. It was the abuse of this discovery that led to the enactment of the Act we have named.

The amount of water which the atmosphere will hold in suspension is considerable. Take for illustration a summer day with a temperature of 82° Fahr., a cubic foot of air will then hold 11·8 grs.; at 70° Fahr., 8·2, while at 100° Fahr. it will hold just ten times as much as at 32° Fahr., or the freezing point of water.

The humidity of the atmosphere is measured by instruments termed hygrometers, of which there are several varieties. The Cotton Cloth Factories Act prescribes the use of that known as Mason's hygrometer, which consists of two thermometers of exactly the same size supported on a suitable stand. One of these is known as the dry bulb, and is generally placed on the left-hand side of the stand. The other is termed the wet bulb. The bulb of this is enclosed in a piece of muslin, from which depends a few lengths of soft-twisted yarn, which dip into a small glass bottle placed below. The water by capillary attraction is drawn up to the muslin round the bulb and saturates it. The large amount of surface exposed facilitates evaporation, and consequently gradually exhausts the water in the bottle, which requires renewal from time to time. It will be obvious from this that the rate of evaporation must depend partly on the temperature at any given time, and partly on the amount of aqueous vapour already held in the atmosphere. If the temperature be low, and the air nearly saturated, the evaporation will be small; but if it be high, and the air comparatively dry, then it will be much greater. It is an axiom in thermostatics that when a liquid is converted into a vapour heat must be taken up to effect the change. Therefore, the water which is evaporated from the muslin requires heat to effect the change, and this it obtains from the bulb of the thermometer, and so reduces its temperature that it registers a lower degree than does the dry bulb, which is not exposed to such

influence. If the rate of evaporation is great, then a great deal of heat is absorbed, and a greater difference is shown between the readings of the two thermometers. But if the air be nearly saturated with vapour, the rate of evaporation will be slow, and the difference between the readings will be reduced considerably, because of the absorption of a less amount of heat from the wet bulb. Hence it will be seen that by noting the differences in the readings of the two thermometers a fair idea of the amount of water present in the atmosphere can be obtained.

Careful experiments have been made to ascertain the proportion of aqueous vapour in the air at different temperatures and under different conditions. The conclusions arrived at are included in the following table, which is the schedule of temperatures and humidity prescribed by the Cotton Cloth Factories Act as those under which work shall be conducted in weaving sheds. This table is the one last sanctioned by the Secretary of State for the Home Department. It gives the maximum limits of humidity at given temperatures, and is therefore of special interest to cotton manufacturers and mill managers:

Grains of vapour per cubic foot of air.	Dry bulb thermometer readings. Degrees Fahr.	Wet bulb themometer readings. Degrees Fahr.	Percentage of humidity. Saturation = 100
1·9	35	33	80
2·0	36	34	82
2·1	37	35	83
2·2	38	36	83
2·3	38	37	84
2·4	40	38	84
2·5	41	39	84
2·6	42	40	84
2·7	43	41	84
2·8	44	42	84
2·9	45	43	85
3·1	46	44	86
3·2	47	45	86
3·3	48	46	86
3·4	49	47	86
3·5	50	48	86
3·6	51	49	86
3·8	52	50	86
3·9	53	51	86
4·1	54	52	86
4·2	55	53	86
4·4	56	54	87
4·5	57	55	87
4·7	58	56	87
4·9	59	57	88
5·1	60	58	88
5·2	61	59	88
5·4	62	60	88
5·6	63	61	88
5·8	64	62	88
6·0	65	63	88
6·2	66	64	88
6·4	67	75	88
6·6	68	66	88
6·9	69	67	88

Grains of vapour per cubic foot of air.	Dry bulb thermometer readings. Degrees Fahr.	Wet bulb thermometer readings Degrees Fahr.	Percentage of humidity. Saturation = 100.
7·1	70	68	88
7·1	71	68·5	88·5
7·1	72	69	84
7·4	73	70	84
7·4	74	70·5	81·5
7·65	75	71·5	79
7·7	76	72	81·6
8·0	77	73	72
8·0	78	73·5	77
8·25	79	74·5	77·5
8·55	80	75·5	77·5
8·6	81	76	76
8·65	82	76·5	74
8·85	83	77·5	74
8·9	84	78	72
9·2	85	79	72
9·5	86	80	72
9·55	87	80·5	71
9·9	88	81·5	71
10·25	89	82·5	71
10·3	90	83	69
10·35	91	83·5	68
10·7	92	84·5	68
11·0	93	85·8	68
11·1	94	86	66
11·5	95	87	66
11·8	96	88	66
11·9	97	88·5	65·5
12·0	98	89	64
12·3	99	90	64
12·7	100	91	64

This table embodies unchanged the figures of the previous schedule, which is now extended to meet cases of temperature below 60° and above 95° Fahr. Column 4 is new, and expresses the percentages of saturation, that is, of the total amount of vapour which the air at that particular dry bulb temperature, is capable of taking up, equivalent to column 1. It will be a practical guide to manufacturers, who will thus perceive readily that the higher the temperature above 73° the drier is the permitted atmosphere.

Whilst the manufacturer has little control over the reading of the dry bulb thermometer which registers the actual temperature of the shed, in winter the latter may be kept at a fairly comfortable working point by introducing heat through the usual steam-pipe appliances or other suitable means. In summer artificial warming is not required. But whatever the reading of the dry bulb is, to avoid the risk of penalties he must keep the wet bulb down to the corresponding temperature given in the schedule. This is accomplished by carefully regulating the amount of steam injected into the atmosphere of the shed, and the attention paid to ventilation. He may of course permit the two thermometers at any time to show a greater difference in the temperatures than that given in the table, because this would indicate a drier atmosphere than that specified, which is the minimum, or least dry, the law allows. If the thermometers show temperatures closer together than those shown in the table, the atmosphere is damper than is allowed by the law, and the employer runs the risk of incurring the penalties laid down for infringing its provisions.

CHAPTER XVI.

Standard Lists of Wages.

The origin of Standard Lists of Wages.—Wages in the transition period; struggles; and the evolution of the "Blackburn Standard List."—Its basis.—Its authors.—Adoption with modifications by other districts.—Necessity for a Uniform List.—The advantages of these Lists to both employers and employed.—The Uniform List:—The standard; width of loom; allowances for broader cloth than admitted by rule; Allowances for narrow cloths, with tables; Reeds; Picks; Twist; Weft; Four-staved Twill; Splits; additions and deductions; time of List coming into operation.—The conferences at which the List was drawn up and signed.—Portions of the old Blackburn List incorporated with the new.—Plain dhooties; dobby dhooties; dhooty headings; additions upon plain cloth prices for satins, drills, drillets; for lenos; for double-lift jacquards; for dobby and tappet motions; exceptions.—Blackburn prices for winding; for patent beam warping; for tape-sizeing or slashing; for looming and drawing; overlookers' poundage.—Burnley prices for winding; for looming and drawing; overlookers' poundage.—Colne District Coloured Goods Weaving List.—Oldham Velvet Weaving List.—Bolton Quilt Weaving List.—Specialties in looms, and the districts in which they are made.—Blackburn makers: Messrs. Henry Livesey, Limited; John Dugdale and Sons; William Dickinson and Sons; Willan and Mills.—Burnley makers: Messrs. Butterworth and Dickinson.—Bury makers: Messrs. Robert Hall and Sons; Hacking and Co.—In other towns: Messrs. Platt Bros. and Co., Limited; Smith Bros.; Richardson, Tuer and Co.—Preparation weaving machinery: Howard and Bullough.—Winding machines: Mr. Joseph Stubbs; Messrs. John Horrocks and Sons; Brooks and Doxey; J. and T. Boyd; and Mr. Thomas Coleby.—Temples and temple makers: Messrs. Lupton Bros.; and J. Blezard and Sons.—Jacquard makers: Messrs. Devoge and Co.; James McMurdo.—Card cutting and card lacing machines: Messrs. William Ayrton and Co.—The end.

IN the cotton manufacturing districts it will generally be found that there is in existence some "standard list," or rate of payment, by which wages are ruled in the

several departments of the establishment. It is not necessary here to discuss the wisdom or unwisdom of the parties to the "Unions" by which these are imposed or maintained—for the "Union" of one side has its counterpoise on the other. Facts, however, cannot be ignored, and it would be folly to shut one's eyes to the power which has accrued to the body of the operatives from combination. In past times serious disputes have arisen between employers and their operatives on the wages question, and efforts have been made by both sides to coerce the other, the instrument employed being combination. This has been met by counter combination, and out of the struggles that have taken place the compromises on the points in dispute have resulted in the establishment of the district standard lists of payment. The first to receive wide recognition and establish its importance was that agreed upon between the employers and operatives of Blackburn in the year 1853.

The Blackburn list became known throughout the cotton trade as the "Blackburn Standard List." Previously to its adoption there was no recognized standard rate of wages for weaving, and the work in its preparatory processes. The trade had only too recently emerged from the hand-loom or manual stage of existence, in which wages were constantly fluctuating, advancing and receding with every change of the market. As many of the hand-loom employers had, and others were transferring their capital and enterprise to the mechanical system then rapidly being perfected, they brought with them the habits to which they had been accustomed of advancing or reducing wages—mostly the latter—on any, or without any pretext whatever. The only check to these proceedings was the resistance of the operatives, who would "strike." These episodes mainly depended upon the presence amongst them of an intelligent and spirited leader, of whom there were not a few, but amongst whom there was no combination or co-operative effort. Thus

numerous and serious irregularities in the wages rate prevailed. From 1848 to 1852 many reductions took place at individual establishments, and it was in an attempt to recover some of these that a combined and determined effort, soon after the inauguration of a complete system of free trade which induced a remarkable degree of prosperity, was made. A 10 per cent. advance of wages was demanded. The movement spread over the entire cotton trade, and was successful until Preston was reached, where, in the great strike of 1853-4 it was defeated.

When the advance was conceded by the Blackburn employers, the question naturally arose as to the basis upon which it should be paid. Inquiries soon showed that the differences existing amounted in some cases almost to 10 per cent. It was then agreed that particulars should be obtained from all the mills in the town and district, an average be struck, and 10 per cent. advanced upon that. This was done.

It may be of interest to mention here that the contending parties had formed opposing combinations of a temporary character, no expectation being entertained that they would become permanent. The operatives had appointed Edward Whittle, one of those clever working men mathematicians who were not scarce amongst them in the first half of the present century, to be their secretary. The employers appointed Mr. William Birtwistle, a cotton manufacturer of their order, assisted by Mr. J. C. Fielden, then a young man in the service of Mr. Birtwistle. These were appointed to work out the details of the Blackburn Standard List, which afterwards became famous as the model upon which all subsequent weaving lists in Lancashire were founded.

This list, with suitable modifications, was quickly adopted as a basis and model by those of Preston, Chorley, and Burnley, the subjacent districts bringing themselves within the comprehension of one or other of these. When the wages movement was wrecked at Preston, after a long

and expensive strike, supported by all the manufacturing districts of Lancashire, the 10 per cent. gained in Blackburn and other districts was soon lost. The operatives, however, had discovered that they were strong when united, and accordingly determined to found a permanent union. It was out of this resolution sprang the celebrated Blackburn Powerloom Weavers' Association. District after district joined it until it embraced nearly the whole of East Lancashire. Some dissensions arose about 1858 which led to a secession, and the formation of the East Lancashire Powerloom Weavers' Association, of which Mr. Thomas Birtwistle, now a factory inspector, became secretary, a position which he held until about 1893, when he received the appointment of "Particulars" inspector.

The principles adopted in these lists have continued to govern the trade ever since, any changes that have occurred having been made by reductions or advances of given percentages from the standard rates embodied in them. As, however, the rates paid under them were not uniform, some districts obtained an important advantage over others because of their ability to undersell them in the market. Burnley was a notable illustration of the working of economic principles in this connection. It obtained a large and rapid concentration of the industry to the disadvantage of the other districts. The present writer drew the attention of the trade to this result in the pages of the "Textile Mercury," and pressing it upon them, a movement was set on foot which resulted in the draughting and adoption of the Uniform Standard List in the weaving branch of the cotton trade. This list came into force in the beginning of August, 1892.

Those who remember the state of matters before these "Standards" were established will readily admit that they have been of the greatest service to the trade. The interest of both sides, therefore, consists in the honourable observance of the compact, and when doubt arises in the minds of the operatives as to the *bonâ fides* of their employer in his

regard for it, the counsel of the writer of these pages is that every opportunity for the strictest investigation should be promptly offered. The belief in the minds of a large body of workpeople, though it may be a mistaken one, that they are not being treated honestly, will lead to such mischievous results, springing from sentiments of retaliation, that any little advantage arising from fractional divergencies from accurate conformity to the List will have to encounter a serious offset. When doubts arise on this point the Secretary of the Weavers' Union should always be a welcome visitor, because this throws upon him the task of disabusing their minds of any misconception—a task which is much more easily accomplished by him than their employer, because his interests are regarded as being identical with theirs. The question being one of calculation, the proper conclusion is easily enough demonstrated, and with a disposition to act justly on both sides, the difficulty is speedily cleared away.

The following is a copy of the Uniform List, probably the most important ever drawn up for the weaving branch of the trade.

(1) The Standard.

The standard upon which this list is based is an ordinarily-made loom, 45 inches in the reed space, measured from the fork grate on one side to the back board on the other, weaving cloth as follows:

Width.—39, 40, or 41 inches.

Reed.—60 reed, 2 ends in one dent, or 60 ends per inch.

Picks.—15 picks per quarter inch, as ascertained by arithmetical calculation, with $1\frac{1}{2}$ per cent. added for contraction.

Length.—100 yards of 36 inches measured on the counter. Any length of lap other than 36 inches to be paid in proportion.

Twist.—28's or any finer numbers.

Weft.—31's to 100's both inclusive.

Price.—30*d.* or 2*d.* per pick.

(2) Width of Looms.

A 45-inch reed space loom being taken as the standard, $1\frac{1}{2}$ per cent. shall be added for each inch up to and including 51 inches; 2 per cent. from 51 to 56 inches; $2\frac{1}{2}$ per cent. from 56 to 64 inches; and 3 per cent. from 64 to 72 inches. $1\frac{1}{4}$ per cent. shall be deducted for each inch from 45 to 37 inches inclusive; and 1 per cent. from 37 to 24 inches, below which no further deduction shall be made. For any fraction of an inch up to the half no addition or deduction shall be made, but if over the half the same shall be paid as if it were a full inch. All additions or deductions under this clause to be added to or taken from the price of the standard loom, 45 inches.

Deducted from Standard.				Added to Standard.			
Loom.	Per Centage.	Loom.	Per Centage.	Loom.	Per Centage.	Loom.	Per Centage.
Inches.		Inches.		Inches.		Inches.	
24	23	35	12	46	$1\frac{1}{2}$	60	29
25	22	36	11	47	3	61	$31\frac{1}{2}$
26	21	37	10	48	$4\frac{1}{2}$	62	34
27	20	38	$8\frac{3}{4}$	49	6	63	$36\frac{1}{2}$
28	19	39	$7\frac{1}{2}$	50	$7\frac{1}{2}$	64	39
29	18	40	$6\frac{1}{4}$	51	9	65	42
30	17	41	5	52	11	66	45
31	16	42	$3\frac{3}{4}$	53	13	67	48
32	15	43	$2\frac{1}{2}$	54	15	68	51
33	14	44	$1\frac{1}{4}$	55	17	69	54
34	13	45	Standard	56	19	70	57
				57	$21\frac{1}{2}$	71	60
				58	24	72	63
				59	$26\frac{1}{2}$		

(3) Broader Cloth than Admitted by Rule.

All looms shall be allowed to weave to within 4 inches of the reed space, but whenever the difference between the width of cloth and the reed space is less than 4 inches it

shall be paid as if the loom were 1 inch broader, and if less than 3 inches, as if it were $2\frac{1}{2}$ inches broader.

(4) Allowance for Cloth 7 to 15 inches Narrower than the Reed Space.

When the cloth is from 7 to 15 inches inclusive narrower than the reed space of the loom in which it is being woven, a deduction in accordance with the following tables shall be made. No further deduction shall be made when cloth is more than 15 inches narrower than the reed space, or when cloth is narrower than 18 inches. Fractions of an inch are not to be recognized under this clause.

Cloth.	72-in. Loom.	Cloth.	71-in. Loom.	Cloth.	70-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
65	1·38	64	1·41	63	1·43
64	2·76	63	2·81	62	2·87
63	4·14	62	4·22	61	4·3
62	5·52	61	5·62	60	5·73
61	6·9	60	7·03	59	7·17
60	8·28	59	8·44	58	8·6
59	9·66	58	9·84	57	9·79
58	11·04	57	11·02	56	10·99
57	12·19	56	12·19	55	12·18

Cloth.	69-in. Loom.	Cloth.	68-in. Loom.	Cloth.	67-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
62	1·46	61	1·49	60	1·52
61	2·92	60	2·98	59	3·04
60	4·38	59	4·47	58	4·56
59	5·84	58	5·96	57	5·83
58	7·31	57	7·2	56	7·09
57	8·52	56	8·44	55	8·36
56	9·74	55	9·69	54	9·63
55	10·96	54	10·93	53	10·9
54	12·18	53	12·17	52	12·16

Allowances for Narrow Cloth—*Continued.*

Cloth.	66-in. Loom.	Cloth.	65-in. Loom.	Cloth.	64-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
59	1·55	58	1·58	57	1·35
58	3·1	57	2·91	56	2·7
57	4·4	56	4·23	55	4·05
56	5·69	55	5·55	54	5·4
55	6·98	54	6·87	53	6·74
54	8·28	53	8·19	52	8·09
53	9·57	52	9·51	51	9·44
52	10·86	51	10·83	50	10·79
51	12·16	50	12·15	49	11·87

Cloth.	63-in. Loom.	Cloth.	62-in. Loom.	Cloth.	61-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
56	1·37	55	1·4	54	1·43
55	2·75	54	2·8	53	2·85
54	4·12	53	4·2	52	4·28
53	5·49	52	5·6	51	5·7
52	6·87	51	7·	50	7·13
51	8·24	50	8·4	49	8·27
50	9·62	49	9·51	48	9·41
49	10·71	48	10·63	47	10·55
48	11·81	47	11·75	46	11·69

Cloth.	60-in. Loom.	Cloth.	59-in. Loom.	Cloth.	58-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
53	1·45	52	1·48	51	1·51
52	2·91	51	2·96	50	3·02
51	4·36	50	4·45	49	4·23
50	5·81	49	5·63	48	5·44
49	6·98	48	6·82	47	6·65
48	8·14	47	8·	46	7·86
47	9·3	46	9·19	45	9·07
46	10·47	45	10·38	44	9·98
45	11·63	44	11·26	43	10·89

ALLOWANCES FOR NARROW CLOTH—*Continued.*

Cloth.	57-in. Loom.	Cloth.	56-in. Loom.	Cloth.	55-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
50	1·54	49	1·26	48	1·28
49	2·78	48	2·52	47	2·56
48	4·01	47	3·78	46	3·85
47	5·25	46	5·04	45	5·13
46	6·48	45	6·3	44	6·09
45	7·72	44	7·25	43	7·05
44	8·64	43	8·19	42	8·01
43	9·57	42	9·14	41	8·97
42	10·49	41	10·08	40	9·94

Cloth.	54-in. Loom.	Cloth.	53-in. Loom.	Cloth.	52-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
47	1·3	46	1·33	45	1·35
46	2·61	45	2·65	44	2·36
45	3·91	44	3·65	43	3·38
44	4·89	43	4·65	42	4·39
43	5·87	42	5·64	41	5·41
42	6·85	41	6·64	40	6·42
41	7·83	40	7·63	39	7·43
40	8·8	39	8·63	38	8·28
39	9·78	38	9·42	37	9·12

Cloth.	51-in. Loom.	Cloth.	50-in. Loom.	Cloth.	49-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
44	1·03	43	1·05	42	1·06
43	2·06	42	2·09	41	2·12
42	3·1	41	3·14	40	3·18
41	4·13	40	4·19	39	4·25
40	5·16	39	5·23	38	5·13
39	6·19	38	6·1	37	6·01
38	7·05	37	6·98	36	6·9
37	7·91	36	7·85	35	7·78
36	8·77	35	8·72	34	8·67

ALLOWANCES FOR NARROW CLOTH—*Continued.*

Cloth.	48-in. Loom.	Cloth.	47-in. Loom.	Cloth.	46-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
41	1·08	40	1·09	39	1·11
40	2·15	39	2·18	38	2·03
39	3·23	38	3·09	37	2·96
38	4·13	37	4·	36	3·88
37	5·02	36	4·91	35	4·8
36	5·92	35	5·83	34	5·73
35	6·82	34	6·74	33	6·65
34	7·72	33	7·65	32	7·57
33	8·61	32	8·56	31	8·5

Cloth.	45-in. Loom.	Cloth.	44-in. Loom.	Cloth.	43-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
38	·94	37	·95	36	·96
37	1·87	36	1·9	35	1·92
36	2·81	35	2·85	34	2·88
35	3·75	34	3·80	33	3·77
34	4·69	33	4·75	32	4·81
33	5·62	32	5·70	31	5·77
32	6·56	31	6·65	30	6·54
31	7·5	30	7·41	29	7·31
30	8·25	29	8·16	28	8·08

Cloth.	42-in. Loom.	Cloth.	41-in. Loom.	Cloth.	40-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
35	·97	34	·99	33	1·
34	1·95	33	1·97	32	2·
33	2·92	32	2·96	31	3·
32	3·9	31	3·95	30	3·8
31	4·87	30	4·74	29	4·6
30	5·65	29	5·52	28	5·4
29	6·43	28	6·32	27	6·2
28	7·21	27	7·11	26	7·
27	7·99	26	7·89	25	7·8

ALLOWANCES FOR NARROW CLOTH—*Continued.*

Cloth.	39-in. Loom.	Cloth.	38-in. Loom.	Cloth.	37-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
32	1·01	31	1·03	30	·83
31	2·03	30	1·85	29	1·67
30	2·84	29	2·67	28	2·5
29	3·65	28	3·49	27	3·33
28	4·46	27	4·32	26	4·17
27	5·27	26	5·14	25	5·
26	6·08	25	5·96	24	5·83
25	6·89	24	6·78	23	6·67
24	7·7	23	7·60	22	7·5

Cloth.	36-in. Loom.	Cloth.	35-in. Loom.	Cloth.	34-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
29	·84	28	·85	27	·86
28	1·69	27	1·7	26	1·72
27	2·53	26	2·56	25	2·59
26	3·37	25	3·41	24	3·45
25	4·21	24	4·26	23	4·31
24	5·06	23	5·11	22	5·17
23	5·9	22	5·97	21	6·03
22	6·74	21	6·82	20	6·9
21	7·58	20	7·67	19	7·76

Cloth.	33-in. Loom.	Cloth.	32-in. Loom.	Cloth.	31-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
26	·87	25	·88	24	·89
25	1·74	24	1·76	23	1·79
24	2·62	23	2·65	22	2·68
23	3·49	22	3·53	21	3·57
22	4·36	21	4·41	20	4·46
21	5·23	20	5·29	19	5·36
20	6·1	19	6·18	18	6·25
19	6·98	18	7·06		
18	7·85				

ALLOWANCES FOR NARROW CLOTH—*Continued.*

Cloth.	30-in. Loom.	Cloth.	29-in. Loom.	Cloth.	28-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
23	·9	22	·91	21	·93
22	1·81	21	1·83	20	1·85
21	2·71	20	2·74	19	2·78
20	3·61	19	3·66	18	3·7
19	4·52	18	4·57		
18	5·42				

Cloth.	27-in. Loom.	Cloth.	26-in. Loom.	Cloth.	25-in. Loom.
In.	Per cent.	In.	Per cent.	In.	Per cent.
20	·94	19	·95	18	·96
19	1·87	18	1·9		
18	2·81				

(5) REEDS.

A 60 reed being taken as the standard, $\frac{3}{4}$ per cent. shall be deducted for every two ends or counts of reed from 60 to 50, but no deduction shall be made below 50. $\frac{3}{4}$ per cent. shall be added for every two ends or counts of reed from 60 to 68; 1 per cent. from 68 to 100; $1\frac{1}{2}$ per cent. from 100 to 110; and 2 per cent. from 110 to 132. All additions or deductions under this clause to be added to or taken from the price of the standard, 60 reed.

(5) REEDS—*Continued.*

DEDUCTED FROM STANDARD.		ADDED TO STANDARD.			
Count of Reed.	Per Centage.	Count of Reed.	Per Centage.	Count of Reed.	Per Centage.
50	3¾	62	¾	98	18
52	3	64	1½	100	19
54	2¼	66	2¼	102	20½
56	1½	68	3	104	22
58	¾	70	4	106	23½
60	Standard	72	5	108	25
		74	6	110	26½
		76	7	112	28½
		78	8	114	30½
		80	9	116	32½
		82	10	118	34½
		84	11	120	36½
		86	12	122	38½
		88	13	124	40½
		90	14	126	42½
		92	15	128	44½
		94	16	130	46½
		96	17	132	48½

(6) PICKS.

Low.—An addition of 1 per cent. shall be made for each pick or fraction of a pick below 11, thus:

Below 11 down to and including 10, 1 per cent.
„ 10 „ „ 9, 2 „
„ 9 „ „ 8, 3 „
„ 8 „ „ 7, 4 „

and so on, adding 1 per cent. for each pick or fraction thereof.

High.—An addition of 1 per cent. per pick shall be made whenever they exceed the following, if using

Weft below 26's when picks exceed 16
„ 26's to 39's inclusive „ 18
„ 40's and above „ 20

In making additions for high picks any fraction of a pick less than the half shall not have any allowance; exactly the half shall have ½ per cent. added; any fraction over the half shall have the full 1 per cent. added.

(7) TWIST.

The standard being 28's, or finer, the following additions shall be made when coarser twist is woven in the following reeds:

Below 28's to 20's in 64 to 67 reed inclusive, 1 per cent.
68 to 71 „ „ 2 „
72 to 75 „ „ 3 „
Below 20's to 14's in 56 to 59 „ „ 1 „
60 to 63 „ „ 2 „
64 to 67 „ „ 3 „

and so on at the same rate. When twist is woven in coarser reeds no addition shall be made.

(8) WEFT.

Ordinary Pin Cops.—The standard being 31's to 100's both inclusive, shall be reckoned equal. Above 100's 1 per cent. shall be added for every 10 hanks or fraction thereof. In lower numbers than 31's the following additions shall be made:

For 30's, add 1 per cent.
„ 29's, 28's, „ 2 „
„ 27's, 26's, „ 3 „
„ 25's, 24's, „ 4½ „
„ 23's, 22's, „ 6½ „
„ 21's, 20's, „ 8 „
„ 19's, 18's, „ 10½ „
„ 17's, 16's, „ 13 „
„ 15's, 14's, „ 16 „

Large Cops.—When weft of the following counts is spun into large cops so that there are not more than 19 in one pound, the following additions shall be made in place of the allowance provided for pin cops in preceding table:

For 29's, 28's,	add	1	per cent.
,, 27's, 26's,	,,	2	,,
,, 25's, 24's, 23's,	,,	3	,,
,, 22's, 21's, 20's,	,,	4½	,,
,, 19's, 18's,	,,	6	,,
,, 17's, 16's,	,,	8	,,
,, 15's, 14's,	,,	10	,,

(9) Four-Staved Twills.

Low Picks.—In four-staved twills an addition of 1 per cent. for each pick or fraction thereof below the picks mentioned in the following table shall be made when using weft as follows:

Below 26's, the addition shall begin at			13
26's to 39's inclusive	,,	,,	14
40's and above	,,	,,	15

High Picks.—When using weft

below 26's, the addition for high picks shall begin at				21
26's to 39's inclusive	,,	,,	,,	22
40's and above	,,	,,	,,	23

In making additions for high picks, any fraction of a pick less than the half shall not have any allowance; exactly the half shall have ½ per cent. added; any fraction over the half shall have the full 1 per cent. added.

(10) Splits.

The following additions shall be made for splits:

One split, uncut, add 5 per cent.
Two splits, ,, ,, 7½ ,,

Empty dents only shall not be considered splits.

(11) Additions and Deductions.

All the foregoing additions and deductions shall be made separately.

This list is subject to a reduction of 10 per cent.

This list shall come into force after the first making-up day in August for cloths requiring a fresh calculation, and on the first making-up day in November next for all cloths.

The foregoing list has been framed at Conferences of Representatives consisting of Mr. T. Thornber, of Burnley; Mr. W. Taylor, of Blackburn; Mr. J. Wilding, of Preston; and Mr. Joshua Rawlinson, of Burnley, General Secretary, on behalf of the employers; and Mr. George Barker, of Blackburn; Mr. Luke Parker, of Preston; Mr. W. H. Wilkinson, of Haslingden; and Mr. Thomas Birtwistle, of Accrington, on behalf of the operatives.

Signed on behalf of the employers,

Joshua Rawlinson,
Secretary of the North and North-East Lancashire Cotton Spinners and Manufacturers' Association.

Signed on behalf of the operatives,

Thomas Birtwistle,
Secretary for the Northern Counties' Amalgamated Associations of Weavers.

June 24th, 1892.

Additions upon Plain Cloth Prices for the following Classes have not been altered.

Plain Dhooties.

There are two systems of paying for dhooties, but in the ultimate result there is very little difference.

The first that was adopted was as follows:

10	yard	dhooties	10	per cent.	above list.
9	,,	,,	11	,,	,,
8	,,	,,	12	,,	,,
7	,,	,,	13	,,	,,
6	,,	,,	14	,,	,,
5	,,	,,	15	,,	,,

The second is 10 per cent. upon all lengths without any deduction being made for width of cloth.

Dobby Dhooties.

Sixteen flush ends or under, with Calcutta heading, 20 per cent.

Sixteen ends and under, with Madras heading, to be paid 30 per cent. on list.

All other dobby borders to be paid 30 per cent., with prices for headings as per "Illustrated Coloured List," agreed upon March 15th, 1886.

Dhooty Headings—Extras for 40ss Yards.

Madras heading to be paid $\frac{1}{4}d.$ for 12, $\frac{1}{2}d.$ for 14 marks, if woven in looms over 39 inches wide, and 1*d.* for 16 to 20 marks, and $1\frac{1}{2}d.$ for 21 to 30, in whatever loom woven.

Large sarrie heading, with 1 shuttle 15 bars, to be paid 1*d.* extra. Small sarrie heading, with 1 shuttle 9 bars, to be paid $\frac{1}{2}d.$ extra.

Madras sarrie heading, with 2 shuttles 11 bars, including cord, to be paid $\frac{1}{2}d.$ extra.

Bombay chocolate heading, with 2 shuttles 14 bars, to be paid 1*d.* extra for 16 marks.

Madras chocolate heading, with 4 shuttles 18 bars, including cord, to be paid 1*d.* per cut extra.

Red Madras heading, with 2 shuttles 10 bars, including cord, to be paid $\frac{1}{4}d.$ for 12 headings, and $\frac{1}{2}d.$ for 14 if woven in looms over 39 inches wide, and 1*d.* for 16 to 20 marks, and $1\frac{1}{2}d.$ for 21 to 30 in any loom.

What is known as 9-bar Bombay heading, with 1 shuttle 11 bars, to be paid 1*d.* extra for 16 marks.

Bombay chocolate heading, with 3 shuttles 14 bars, to be paid 1*d.* extra for 16 marks.

Ordinary Calcutta heading, with 5 bars, no extras.

Additions upon Plain Cloth Prices under an Agreement made with Nelson Employers, October 4th, 1886.

Satins, Drills, Drillets, etc.

Cloths up to and including 25 picks to be paid 8 per cent. on plain cloth prices, and for every additional pick or fraction beyond the half, an extra $\frac{1}{2}$ per cent. shall be added. These additions to be made in place of the allowance for picks in Clause 6.

Whenever the reed per $\frac{1}{4}$ inch exceeds the pick, $\frac{3}{4}$ per cent. shall be added for every additional two counts of reed above the number of picks.

Lenos.

For one doup, 70 per cent.; two doups, 80 per cent. on plain cloth prices.

Additions upon Plain Cloth Prices under an Agreement entered into at Chorley, February 24th, 1886.

Double-Lift Jacquards.

To be paid the following over and above plain cloth prices:

For plain grounds, 30 per cent.
For satin grounds, 25 ,,

Brocades, damasks, and stripes created by a variation

of the number of ends, 3, 4, or more in a dent, to be paid for by the number of ends per inch.

Picks 18 to 30, 1 per cent. per pick; from 30 to 40, $\frac{3}{4}$ per cent.; all above 40, $\frac{1}{2}$ per cent., instead of 1 per cent.

Lace brocades, 5 per cent. extra.

When single-lift machines are used, the scale shall be 10 per cent. higher than the above.

The above applies to jacquards only.

Dobby and Tappet Motions, Satins Excepted.

To be paid the following on plain cloth prices.

Up to and including:

4 staves,	12	per cent.		13 staves,	21	per cent.	
5	,,	13	,,	14	,,	22	,,
6	,,	14	,,	15	,,	23	,,
7	,,	15	,,	16	,,	24	,,
8	,,	16	,,	17	,,	25	,,
9	,,	17	,,	18	,,	26	,,
10	,,	18	,,	19	,,	27	,,
11	,,	19	,,	20	,,	28	,,
12	,,	20	,,				

Stripes and other cloths, with more than two ends in a dent, to be paid for by the number of ends per inch.

In single shuttle checks, handkerchiefs, and all other special classes of goods in which more than one pick is put in one shed, all lost picks shall be counted.

Exceptions.

Plain handkerchiefs, 72 reeds and below, to be paid 5 per cent. extra.

Single shuttle cord checks, with more than two picks in one shed, to be paid $2\frac{1}{2}$ per cent. less.

Lace stripes, fly-overs, or any other goods of a special character, shall be paid extra as per special arrangement,

to be agreed upon by the Employers' and Operatives' Associations.

Blackburn Prices for Winding,

Subject to a Reduction of 10 *per cent.*

Counts of Yarn.	Lbs. of Twist for 12*d.*	Counts of Yarn.	Lbs. of Twist for 12*d.*
18's	55 lbs.	38's	32 ,,
20's	52 ,,	40's	31 ,,
22's	49 ,,	46's	$27\frac{1}{2}$,,
24's	$45\frac{1}{2}$,,	50's	26 ,,
26's	$42\frac{1}{2}$,,	60's	22 ,,
28's	40 ,,	70's	19 ,,
30's	38 ,,	80's	$16\frac{1}{2}$,,
32's	36 ,,	90's	$14\frac{1}{2}$,,
34's	$34\frac{1}{2}$,,	100's	13 ,,
36's	$33\frac{1}{2}$,,		

Blackburn Prices for Patent Beam Warping,

Subject to a Reduction of 10 *per cent.*

Ends.	Price per cent. or 3,000 yards.	Ends.	Price per cent. or 3,000 yards.
300	3·12*d.*	410	4·11*d.*
310	3·21*d.*	420	4·20*d.*
320	3·30*d.*	440	4·40*d.*
330	3·39*d.*	460	4·60*d.*
340	3·48*d.*	480	4·80*d.*
350	3·57*d.*	500	5·01*d.*
360	3·66*d.*	520	5·22*d.*
370	3·75*d.*	550	5·55*d.*
380	3·84*d.*	580	5·88*d.*
390	3·93*d.*	610	6·21*d.*
400	4·02*d.*	640	6·54*d.*

The above prices are considerably below what is generally paid for Warping; this, to some extent, arises from the application of the stop-motion.

Blackburn Prices for Tape-Sizeing or Slashing,

Subject to a Reduction of 10 *per cent.*

In consequence of so many different lengths being made, the 100 yards has been added, it being so much simpler to calculate from, as the 100 yards' price only requires to be multiplied by the length, whatever it may be, removing the decimal point two figures more to the left.

Through some errors having crept into the original list, the following table will be found to differ slightly therefrom, as the calculations have been worked out strictly in accordance with the standard, irrespective of the prices given in the original list of 1867.

Taking 2,460 ends as a standard, deduct $\frac{3}{8}d.$ for every 50 ends below the standard, on 100 cuts of $37\frac{1}{2}$ yards.

Taking 2,460 ends as a standard, add $\frac{1}{2}d.$ for every 50 ends above the standard, on 100 cuts of $37\frac{1}{2}$ yards.

Fractional parts of 50 ends given in favour of the workman.

Ends.	1260 to 1310	1360 to 1410	1460 to 1510	1560 to 1610	1660 to 1710	1760 to 1810	1860 to 1910
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
25 yards . .	13·	13·5	14·	14·5	15·	15·5	16·
$37\frac{1}{2}$,, . .	19·5	20·25	21·	21·75	22·5	23·25	24·
46 ,, . .	23·92	24·84	25·76	26·68	27·6	28·52	29·44
60 ,, . .	31·2	32·4	33·6	34·8	36·	37·2	38·4
100 ,, . .	52·	54·	56·	58·	60·	62·	64·

Ends.	1960 to 2010	2060 to 2110	2160 to 2210	2260 to 2310	2360 to 2410	2460 to 2510	2560 to 2610
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
25 yards . .	16·5	17·	17·5	18·	18·5	19·	19·66'
$37\frac{1}{2}$,, . .	24·75	25·5	26·25	27·	27·75	28·5	29·5
46 ,, . .	30·36	31·28	32·2	33·12	34·04	34·96	36·19
60 ,, . .	39·6	40·8	42·	43·2	44·4	45·6	47·2
100 ,, . .	66·	68·	70·	72·	74·	76·	78·66

Tape-Sizeing or Slashing—*continued.*

Ends.	2660 to 2710	2760 to 2810	2860 to 2910	2960 to 3010	3060 to 3110	3160 to 3210	3260 to 3310
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
25 yards . .	20·33	21·	21·66'	22·33'	23·	23·66	24·33
$37\frac{1}{2}$,, . .	30·5	31·5	32·5	33·5	34·5	35·5	36·5
46 ,, . .	37·41	38·64	39·86	41·09	42·32	43·55	44·77
60 ,, . .	48·8	50·4	52·	53·6	55·2	56·8	58·4
100 ,, . .	81·33	84·	86·66	89·33	92·	94·66	97·33

Ends.	3360 to 3410	3460 to 3510	3560 to 3610	3660 to 3710	3760 to 3810	3860 to 3910	3960 to 4010
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
25 yards	25·	25·66'	26·33	27·	27·66	28·33'	29·
$37\frac{1}{2}$,,	37·5	38·5	39·5	40·5	41·5	42·5	43·5
46 ,,	46·	47·23	48·45	49·68	50·91	52·13	53·36
60 ,,	60·	61·6	63·2	64·8	66·4	68·	69·6
100 ,,	100·	102·66'	105·33'	108·	110·66'	113·33	116·

The preceding list is based upon medium counts of yarn. Extreme counts and sorts to be allowed for as per agreement.

Blackburn Prices for Looming and Drawing.

Looming plain sorts .	$3\frac{7}{16}d.$	per 1,000 ends.
Drawing plain sorts .	$4\frac{7}{16}d.$	,, ,,
Drawing dhooties . .	$5d.$	,, ,,

Three and five-leaf twills, double warps, Yarns below 16's, fine reeds, and other special goods to be paid extra as per agreement. Jobbing or labouring to be paid by the hour.

The above prices are not subject to 10 per cent. reduction.

The above are the prices to be paid until the new list for looming and drawing is complete, which is now under consideration.

Blackburn Overlookers' Poundage.

Ordinary shirtings . .	1*s.* 4*d.* to 1*s.* 5*d.*
Jaconets	1*s.* 4*d.* to 1*s.* 5*d.*
Twills	1*s.* 4*d.* to 1*s.* 7*d.*
Staved work . . .	1*s.* 4*d.* to 1*s.* 8*d.*
Dhooties	1*s.* 4*d.* to 1*s.* 6*d.*
Dobbies	1*s.* 5*d.* to 1*s.* 10*d.*

The above are not subject to the 10 per cent. reduction, it having been previously deducted from the weavers' wages.

Burnley Prices for Winding.

The net standard price for winding at Burnley is 6½*d.* for 20 lbs. of 32's twist, and the following table is an arrangement therefrom:

Counts.	Price for 1 lb.	Counts.	Price for 1 lb.	Counts.	Price for 1 lb.
	d.		*d.*		*d.*
18's	·2157	46's	·4275	74's	·6576
20	·2285	48	·4463	76	·6754
22	·2435	50	·457	78	·6932
24	·2608	52	·4753	80	·7109
26	·2773	54	·4936	82	·7287
28	·2929	56	·5033	84	·7465
30	·3093	58	·5213	86	·7643
32	·325	60	·5332	88	·7820
34	·3401	62	·551	90	·7998
36	·3547	64	·5687	92	·8176
38	·3686	66	·5865	94	·8353
40	·3839	68	·6043	96	·8531
42	·3988	70	·6221	98	·8709
44	·4134	72	·6398	100	·8887

Burnley Prices for Looming and Drawing,

Recognized by the Twisters' Association.

NET PRICES FOR PLAINS.

Twisting	26's to 38's . . .	3¾*d.* per 1,000 ends.
,,	16's to 24's and 40's to 70's	4*d.* ,, ,, ,,
,,	under 16's . . .	4½*d.* ,, ,, ,,
,,	over 70's to 100's . .	4½*d.* ,, ,, ,,
Drawing	up to 70's reeds . .	6*d.* ,, ,, ,,
,,	70's to 100's . . .	6½*d.* ,, ,, ,,

Burnley Overlookers' Poundage.

NET PRICES.

Plain cloths . .	1*s.* 1*d.* to 1*s.* 3*d.*
Twills . . .	1*s.* 3*d.* to 1*s.* 5*d.*
Jeanettes . .	1*s.* 3*d.* to 1*s.* 5*d.*
Dobbies . . .	1*s.* 4½*d.* to 1*s.* 9*d.*
Splits . . .	1*s.* 2*d.* to 1*s.* 5*d.*
Dhooties . . .	1*s.* 3*d.*
Drills . . .	1*s.* 3½*d.*

The above matter constitutes the current Uniform List. Anything that may appear elsewhere in addition to it is by way of elucidation or comment, and not binding as an integral part of the agreement. Space will not allow of any comment or explanation.

The three following lists govern the other important sections of the weaving industry that do not come within the scope of the Uniform List.

Coloured Goods Weaving.

The following is the standard of the Colne district list (agreed to in 1890) for coloured goods, no change having taken place since then up to the end of 1893:—

The standard upon which the price for plain and striped goods is based is as follows:—

Cloth.—28, 29, or 30 inches in width.

Reed.—52 to 64 both inclusive, or 26 to 32 dents per inch, two ends in a dent.

Length.—74 yards of warp, 36 inches to the yard.

Weft.—16's or any finer counts.

Price.—$1\frac{1}{2}d.$ per pick.

The standard upon which the price for checks is based is 70 yards of warp, $2d.$ per pick; in all other particulars the same as the standard for plain and striped goods.

The standard of the list of prices—agreed to in 1892, and still in operation without change—for coloured goods for Radcliffe and district is as follows:—

Cloth.—The list shall be based on cloth, 36 inches to the yard, and 100 yards long.

Reed.—56 reed, *i.e.*, 28 dents to the inch, and two ends in a dent.

Width.—27 to 30 inches measured on the counter in an unfinished state as it comes from the Loom.

Weft.—20's or any finer counts.

Shuttles.—Two.

Looms.—Drop box.

Warps.—Full (or hand) dressed or sectional warps.

Price per pick, per $\frac{1}{4}$ inch—$3{\cdot}4d.$ or $3d.$ and 2-5ths, as ascertained by wheel calculation with $1\frac{1}{2}$ per cent. added for contraction.

Velvet Weaving.

Velvet weaving is chiefly carried on in the Oldham district, and in this trade a somewhat different principle of arranging a standard list is adopted, the measurement being by weight of weft rather than by picks. The list was agreed to in 1888, but only the basis with allowances for weft came into operation in that year, the full list not being finally adopted until October, 1890. No change in the list has taken place since its introduction.

The basis of the list is as follows:—

45	and	49	looms	weaving 56's weft,	$7d.$ per lb.
50	,,	54	,,	,,	$6\frac{13}{16}d.$,,
55	,,	59	,,	,,	$6\frac{11}{16}d.$,,
60	,,	64	,,	,,	$6\frac{9}{16}d.$,,
65	,,	69	,,	,,	$6\frac{1}{2}d.$,,
70	,,	74	,,	,,	$6\frac{3}{8}d.$,,
75	,,	79	,,	,,	$6\frac{1}{4}d.$,,
80	,,	84	,,	,,	$6\frac{1}{8}d.$,,
85	,,	89	,,	,,	$6d.$,,

Whenever the looms are narrower than the above table $\frac{3}{16}d.$ per lb. shall be added for each range of 5 inches, and if broader $\frac{1}{8}d.$ per lb. shall be deducted for each similar range.

Quilt Weaving.

Quilts of various kinds are chiefly woven in the Bolton District, and there is in operation a price list mutually agreed to by employers and operatives through their associations. The list for Toilet and Marseilles quilts dates back to January, 1862, but in 1890 a list of prices for weaving Honeycomb, Alhambra, and Tapestry quilts was added thereto.

The list, or basis for Honeycomb quilts woven with one shuttle, is the shortest and simplest, and may be quoted as a specimen.

Counts of Reed reckoned 1 end per dent.	Width in Reed exclusive of Fringe.	Picks for $\frac{1}{8}$th of a Penny.	Counts of Reed reckoned 1 end per dent.	Width in Reed exclusive of Fringe.	Picks for $\frac{1}{8}$th of a Penny.
	Inches.			Inches.	
36	58	118	36	77	99
,,	59	117	,,	78	98
,,	60	116	,,	79	97
,,	61	115	,,	80	96
,,	62	114	,,	81	95
,,	63	113	,,	82	94
,,	64	112	,,	83	93
,,	65	111	,,	84	92
,,	66	110	,,	85	91
,,	67	109	,,	86	90
,,	68	108	,,	87	89
,,	69	107	,,	88	88
,,	70	106	,,	89	87
,,	71	105	,,	90	86
,,	72	104	,,	91	85
,,	73	103	,,	92	84
,,	74	102	,,	93	83
,,	75	101	,,	94	82
,,	76	100			

A 36 reed or 18 dents, being the standard, is made the starting point:—Two picks to be added for $\frac{1}{8}$th of a penny for a decrease of eight counts of reed, and deducting two picks for $\frac{1}{8}$th of a penny for an increase of eight counts of reed.

The above prices are for honey combs with fringes, Grecians, and honey combs without fringe, with a fret at the ends to have 10 picks extra for $\frac{1}{8}$th of a penny if there is not more than 12 inches of empty reed space; if there is more than a total of 12 inches of empty reed space, to be paid as fringed honey combs.

Coloured stripes in warp $\frac{1}{8}$th of a penny per quilt extra.

Coloured border in warp and weft $\frac{1}{4}d.$ per quilt extra.

Brocade stripes, 10 per cent. extra.

Any of the afore-mentioned quilts, if woven with a second shuttle (drop box at one side only), to be paid 10 per cent. extra, if woven with a third shuttle (drop box at one side only) to be paid 20 per cent. extra.

Honey comb quilts woven with two shuttles (pick and pick) to be paid 20 per cent. extra to one shuttle price, three shuttles (pick and pick) 30 per cent. extra to one shuttle price.

Specialties in Looms.

It will have been obvious that in tracing the development of the loom in the preceding pages, it was impossible to follow the subject into its side issues. To have done so would have required almost another volume. These issues have resulted in the invention and construction of specialties in looms for almost every purpose and requirement conceivable in connection with the textile industries. But they cannot be described on account of the exigencies of space. Still, as the reader may desire to know where such looms may be obtained, the following notes on the productions of the leading loom makers may be of service in directing the quest.

Naturally loom making flourishes most in the great weaving districts of Lancashire, and it is in the midst of these that the principal loom-making establishments are found.

Blackburn is a chief centre of the weaving trade of Lancashire, and it has four important machine shops making weaving and preparation machinery.

Messrs. Henry Livesey, Limited, have a large and growing establishment, and make looms from 24 to 140-inch reed space in width. Besides making all classes of looms suitable for the Lancashire trade, they make many varieties and specialties suitable for home and foreign markets, and with the adjuncts necessary for the production of plain and figured fabrics in the various types of tappet, dobby, and jacquard appliances. Checking looms with rising and revolving boxes, and with the

best and most recently invented motions, including Eccles' patent. Winding, warping, size-mixing, sizeing, and all the machinery etceteras of the preparation department are also included.

Messrs. John Dugdale and Sons is an old and well known firm making the looms usually required in the Lancashire weaving districts, and for districts abroad engaged in the production of similar fabrics. The firm also makes a number of specialties for various purposes, including the Wright Shaw check loom described in detail in the preceding pages. Preparation machinery of a high quality is also included in their production.

Messrs. William Dickinson and Sons is another well known and old-established firm of loom makers, whose founder was the inventor of the "Blackburn loom," otherwise known as the side-pick loom, which is the most extensively used of all picking methods. There are more power-looms of this type than of all others put together. This firm makes a good loom suitable for all classes of Lancashire cotton goods. It also makes winding, warping, and sizing machinery with the latest improvements in details.

Messrs. Willan and Mills is another well known firm of loom makers which has been in the business for about half a century. This firm makes the several varieties of looms in request by the Lancashire trade, and for markets abroad producing similar classes of goods. Plain, twill, check, and looms for the production of figured goods, with all sorts of adjuncts for the production of variety of effects are included. Also preparation machinery.

Burnley is another great centre of weaving in Lancashire, the productions of which differ somewhat from those of Blackburn. The specialty loom of this district is a light, narrow, quick-running loom, making about 240 to 260 picks per minute, and mainly employed for the production of the light printing cloths for which the town has a great reputation.

Messrs. Butterworth and Dickinson, a loom-making firm in this town, have attained a high reputation for their weaving machinery. They make all descriptions of looms for cotton, linen, worsted, woollen, and silk goods in all widths, and with loose or fast reeds; and revolving and drop-box looms, including the "Eccles patent." The preparation machinery includes several specialties, amongst which may be mentioned Bethel's sectional warping machine previously described in detail, warp balling machines, and ball warp beaming machines; and with the sizing machine several of the firm's patented improvements.

Messrs. Howard and Bullough, Accrington, the great cotton-spinning machinery makers, make preparation machinery for the weaving department. In this department they have many important specialties in inventions relating to warping and sizeing machines, especially the latter. Some of these have been already described in detail in the preceding chapters. This firm also supplies looms of all kinds.

The town of Bury is the centre of another great weaving district, differing considerably from the two already mentioned. The fabrics produced in this district are light and heavy woven coloured goods, cotton velvets, velveteens, cords, moleskins, cotton and union ticks, and many varieties which cannot be enumerated. The looms for these classes, which form a large variety, are mainly made in Bury and neighbourhood.

It is in Bury that the most remarkable specialties in looms are made, these being for almost every conceivable purpose, and for every specialty in textile fabrics required in all the textile industries, both in and outside of the cotton trade.

The firm of Messrs. Robert Hall and Sons, Bury, Limited, besides all the ordinary types of looms, make the following specialties for cotton fabrics:—Sponge cloth and cross-weaving looms; needlework netting looms; cotton belting and hose-pipe looms; cotton

blanket and sheeting looms; canvass looms; Alhambra quilting, toilet, and pique looms; Marseilles quilt looms; corset cloth looms; pick-and-pick looms; drop and circular box looms; cotton trousering looms; dobby and jacquard looms; candlewick and tape looms; sail-cloth looms; sugar-bag looms; Turkish towel looms; and paper machine cotton-felt looms. This firm also make all sorts of specialties in looms for the other textile industries. Preparation machinery in numerous specialties is also produced in their establishment.

Messrs. Hacking and Co., of the same town, make all kinds of specialties in looms required to make a somewhat lighter type of goods. These include looms for weaving all kinds of fustian goods; for strong linen and cotton goods; nankeens; drills; cotton, union, and linen ticks; huckabacks; regattas and drabbetts; under and overpick looms for light and heavy ginghams and checks; handkerchiefs; plain and fancy silk goods; drop and circular box looms; looms for leno, gauze, and cross-bordered goods; lappet, pick-and-pick, and dobby and jacquard looms for all kinds of figured goods.

Messrs. Platt, Brothers, and Co., Limited, Oldham, are extensive makers of high class looms chiefly for the heavy classes of cotton goods. They have also a recently-invented specialty, a loom for weaving coloured bordered goods with grey or different coloured centres. The borders are filled with wefts of a different colour from that of the centre. Briefly described, the loom may be called a triple loom, consisting of a wide centre loom of the usual type, having a ribbon loom attached at each end of the centre lay. The junction of the borders with the centre cloth is easily effected. This loom was fully described and illustrated in the "Textile Mercury" of August 11th, 1894.

Messrs. Smith Brothers, Heywood, make looms similar to those made in Bury.

Messrs. Richardson, Tuer, and Co., make the classes of looms generally in use in the South Lancashire district

for weaving plain and fancy fabrics, such as heavy toilets, quilts, fustians, cords, moles, velvets, heavy and light checks, ginghams, and twills. Also the adjuncts suitable for such looms, pirn winding machines, etc.

So varied are the requirements of the manufacturing division of the cotton trade that they have led to the subdivision of the business of making the necessary machinery in several instances. These are in: winding machinery, loom temples, jacquards, shuttles, pickers, healds, reeds, and the leather furniture of looms. Sizeing flours and chemicals also form important adjuncts.

Mr. Joseph Stubbs, Manchester, is a well known maker of every description of yarn winding and reeling machinery, including a great number of specialties for single, double, and many fold thread winding, gassing, bundling, etc.

Messrs. John Horrocks and Sons' is an old-established firm of winding machine makers, producing stop-motion drum doubling winding, re-winding, and cross-winding machines, and cup, quill, and pirn winding machines.

Messrs. Brooks and Doxey, makers of cotton-spinning machinery, have also some specialties in winding machinery, amongst which may specially be mentioned the Hill and Brown patent winding machine for winding yarn upon paper tubes and dispensing with flanged bobbins.

Mr. Thomas Coleby's patent reels and bundling press have already been described.

Messrs. J. and T. Boyd, Shettleston Ironworks, near Glasgow, is another eminent firm, making all classes of winding and twisting machinery, including numerous specialties for the cotton and other textile industries.

There is one indispensible adjunct of the loom which we find has not received the notice it deserves in the preceding pages. This is the "temple," the instrument which keeps the cloth expanded during the weaving process to a width as nearly as possible coincident to that of the warp in the reed. This is necessary to prevent the edge threads of the warp being broken, or pulled in so as to narrow the

cloth by the drag of the weft as it is being inserted. There are a very large variety of these temples, as will readily be conjectured from the immense variety of fabrics made. The manufacture of these has also become a special business.

Messrs. Lupton Brothers, Accrington, are large makers of temples, having several hundred varieties for the cotton and the other textile industries. The types are mainly the roller, ring, segment, and star kinds, with numerous modifications in each.

Messrs. J. Blezard and Sons, Padiham, is an old-established firm of temple makers, making numerous varieties for the various branches of the textile trades.

The Jacquard is an important adjunct of fancy weaving, and the making of these has also developed into an independent business. The principal makers are: Messrs. Devoge and Co., Manchester, Mr. James McMurdo, Manchester.

There are also adjuncts to the Jacquard machine, namely, card cutting and card lacing machines. Messrs. William Ayrton and Co., Manchester, make these machines. Messrs. The Singer Manufacturing company, the great sewing machine makers, make a card lacing machine.

The other special businesses that have grown out of efforts to supply the ever-increasing wants of the principal trade do not call for detailed notice.

The particular mention here made of the leading firms is due to and is given in recognition of the facilities they have accorded and the information they have given to the writer in the preparation of this work, which is now committed to the classes of readers for whom it has been mainly written, in the hope and trust that the information given will be found both interesting, instructive, and suggestive of further improvements.

THE END.

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