treated in such an exhaustive manner. That portion of the work devoted to mildew is certainly valuable. The first part is—well, instructive, to say the least, though we sincerely trust that the art, as practiced in England, will not find favor in the eyes of American manufacturers.

Touching the practice of heavy sizing, the authors say in their preface that it does not concern them immediately; still, if there be a demand for weighted cottons, and they are properly described, they see no reason why the demand should not be met. The practice of regarding heavy sizing as an adulteration, they say substantially, in another place, they do not consider at all logical; as they 'fail to grasp a parallel that a man commits a fraudulent act who coats a white metal tea service with silver, or plates a set of harness with nickel." They argue that as the manufacturer does not sell direct to the consumer, but to the trader, and simply makes such a line of goods as the trader calls for, therefore the practice of making three pounds of shirting out of one pound of cotton and two pounds of clay and other materials, is perfectly legitimate, or as much so as plating white ware with silver.

The argument would be more convincing and the parallel juster if it were assumable that the makers of plated articles were in all cases well aware that their goods were to be imposed upon unintelligent buyers as pure silver, and took pains to abet the frauds by marking their wares accordingly. The fact that for a time such dishonest products have been disposed of in enormous quantities, as our authors frankly assert, is no proof that there is a real demand for them from consumers; and the loss of favor which English cottons have experienced in China and elsewhere, rather goes to show that many buyers of such goods have been swindled, and that in the long run the practice of overloading cottons will be found the reverse of profitable. But we did not set out to discuss the morality of heavy sizing, or the policy of it, but rather to describe the materials used and the way they are applied.

To a limited extent sizing is a process not only legitimate but really necessary in cotton weaving with single yarn. Its object is to bind the fibers together to strengthen the warp to enable it to withstand the strain of the loom, and to diminish the fraying action of the reed by giving the thread a smooth and even surface. This is especially necessary when the staple of the cotton is short and the fibers but loosely bound together in the spinning of the yarn. For this legitimate purpose starch paste is quite sufficient. With pure starch size it is easy to add 20 per cent to the normal weight of the cotton. By adding other ingredients the loading can be and is increased tenfold or more. To describe the elaborate machinery used in sizing would carry this article beyond the space allowable, besides diverting it from its intended purpose.

The various systems of sizing are classed as follows: 1. Sizing the yarn when on the loom. 2. Sizing in the hank. 3. Sizing the yarn in the warp or chain. 4. Sizing the yarn when spread out so as to represent a sheet, each thread being as nearly as possible at an equal distance from its neighbor. The first method is exclusively practiced by the hand loom weaver, and is of slight importance, very little weaving of that sort being done now except in China and India. For power loom weaving sizing in the hank is exclusively confined to colored goods. This method, like the former, is falling into disuse. The sizing of ball warps and chains is more largely practiced, and consists of two operations, the sizing and the drying. In the first the yarn is run between squeezing rollers to exclude the air, then through a box (sow-box) filled with size, then between another pair of rollers to squeeze out the excess of size. The drying is done over steam heated cylinders. The fourth and most important method of sizing is chiefly practiced on the Slasher sizing machine, which sizes and dries the yarn, and otherwise prepares it for the loom by one continuous though complex process.

The authors give an analysis of a sample of heavily sized warp, as follows:

Cotton fiber.	Pure cotton	33·18	
	Natural moisture	2·65	35·88
Size.	Starchy matters	16·16	
	Moisture with size	7·81	
	Fats	3 04	27·01
Mineral.	Natural ash	1·00	
	China clay	32·07	
	Chloride of magnesium	3·25	
	Chloride of zinc	0·84	37·16
			100·00

Thus it appears that in every hundred pounds of such warp there are about 36 pounds of cotton fiber, 27 pounds of size, and 37 pounds of mineral "loading." In other words, for every pound of pure cotton there is a pound and seven-ninths of foreign matter. A little further on the authors say that "common eight and a quarter pound shirtings are usually very heavily sized," and give analyses of two samples, one showing 3 pounds 6 ounces of size to 4 pounds 13 ounces of cotton, the other giving 3 ounces more of size and so much less of cotton.

The authors are careful to say that sizing and weighting should be considered as two distinct processes. "The former is a necessity, the latter not necessarily so." There is still another loading operation carried on by people called "stiffeners," who take the cloth, after it has been sold by the manufacturers and give it an additional load of clay, gypsum, heavy spar, Epsom and Glauber's salts, starch, tallow, and so on. The authors considerately remark that this practice "cannot, of course, be defended upon any ground save that of cheapening the fabric. Some merchants, however, find this to be necessary;" though it is not easy to see how a finished fabric can be made cheaper even by adding to it so cheap a substance as clay—unless a portion of the clay can be palmed off upon the consumer as cotton. It was shown in the somewhat famous Manchester goods case, a year ago, that the cost of the sizing compound was just 3 farthings a pound, or about one-tenth the cost of cotton. In the case in question the cotton in dispute had 4 pounds of size to 4 pounds 3 ounces of fiber

The various materials used in sizing are of four classes. (1) Starchy matters used to strengthen the yarn and facilitate the weaving; (2) fatty substances used to soften, that is, to allay the harsh and dusty feel of dry starch; (3) other organic substances; and (4) mineral matter used to increase the weight of the goods. To prevent mildew a large number of antiseptic substances are also employed. All these articles are described at great length, with their special properties and the manner of preparing and using them. For pure sizing the starches most generally used are those of the potato, sago, and wheat. Farina gives a harsher feel than sago, making a more liberal use of fatty matter necessary. Deliquescents are also required, especially when clay has been used, to keep the clothes from becoming dusty. Tapioca, corn starch, rice flour, arrow root, and other starches are often used. In the second class fall tallow, cocoanut oil, palm oil, castor oil, olive oil, animal and vegetable waxes, paraffine, etc. In the third class are glucose, glycerine (which gives a nice soft feel to the cloth, especially in conjunction with much china clay, and which with dextrin and alum makes the dressing for fine muslin yarn), dulcine (a mixture of glycerine, gum, and Chinese wax, introduced into Manchester by two of our authors), Irish moss, glue, old lant, or urine, and various soaps.

In the class of mineral substances we find china clay (disintegrated feldspar), steatite (soapstone or silicate of magnesia), sulphate of lime (plaster of Paris, gypsum, terra alba, etc.), sulphate of magnesia (Epsom salts), sulphate of baryta, or heavy spar, sulphate of soda, or Glauber's salts, silicate of soda, or water glass, and ultramarine blue. All these serve to increase the weight of the fabric. To them are added chloride of calcium mixed with the chlorides of magnesia and zinc for purposes of adulteration.

Chloride of calcium is a deliquescent pure and simple, and serves the purpose of keeping the china clay moist during the weaving process. The authors say that it should never be used for weighting purposes. "Weight can be much more easily and safely introduced by means of china clay than by deliquescent substances." Chloride of magnesium is often used as an antiseptic, but the authors are confident that without an admixture of chloride of zinc it will not prevent mildew.

These various materials variously mixed are applied by the makers of cotton goods to the warp only. The weft is not sized for the weaving process. But this leaves too much unloaded fiber to suit the English merchant. Accordingly, as the authors remark, "it is an established custom to stiffen already heavily sized goods after they have left the manufacturers' hands. Ordinary 7 pound gray shirtings are filled with size, Epsom salts, Glauber's salts, or mixtures of these, so as to make them weigh and resemble, as far as possible, 8¼ pound shirtings." This adulteration is easily seen, since both the warp and the weft threads, and also the interstices, contain foreign matter, "exactly as bleached and filled goods do."

MAKING KNIT COTTON GOODS TO IMITATE WOOL.

When knit shirts and drawers were first introduced, a large proportion of the substance of the goods was wool. The great extent to which cotton is now used in the manufacture of knit undergarments makes it almost ridiculous to speak of these articles of apparel as "flannels." It is now nearly fifty years since the first successful power knitting machine was made. And here, by the way, it may be interesting to remark that, although a hand machine had been in use in England for nearly two centuries, and numerous efforts had been put forth to adapt it to run by power, it was reserved to an American to succeed in this direction. An enterprising storekeeper in Albany, N. Y., saw the need of such an invention, and hired a young man then working in a cabinet shop there to make the attempt. The latter purchased on old hand frame for $55, in April, 1831, on which he commenced his experiments, and in six days had so arranged the apparatus that it would knit by turning a crank at the side.* In the fall of 1832, the invention had become so far a practical success that a small factory was then started to make knit goods with it in Cohoes, N. Y., and the old "reciprocating frame," then first put into use, not only made the fortunes of the storekeeper and the inventor, who set out in so business-like a way to accomplish their object, but started an industry which has since become of vast magnitude.

At first, as we have said, the material used consisted largely of wool. It was not until after several years that it was found that one half cotton would make a good serviceable article, but then and ever since it has been customary to sell these knit undergarments, wherever possible, as woolen fabrics. The experienced housekeeper, or ladies who purchase their own dress materials sufficiently to become somewhat acquainted with the difference between cottons and woolens, probably know better, but the great majority of customers for the goods do not. There are few people, however, we venture to say, who suppose that, in purchasing these goods, they are buying fabrics with absolutely *no* wool in them. Yet such is really the case in a large proportion of the goods made. It is probable that fully one half of all the knit shirts and drawers made in this country are manufactured from cotton exclusively, and, where any wool is used, it forms a very small proportion of the total weight of the fabric. We know of one manufacturer who, two years ago, made up a lot of goods in which he put twenty per cent wool; but he found it difficult to get more for them than others obtained for an all-cotton article; his conclusion was that fabrics containing so much wool were "too good" for the general market, and he has since used cotton only.

But, with the substitution of cotton for wool, the manufacturers have constantly been making strenuous efforts to produce goods which would look as though they were made of wool. Great attention has been paid to the bleaching and dyeing, and, in making white goods, two or three particular shades of white are given to the fabrics, according as it is desired to represent Texas, Ohio, or California wools, etc. In the dyeing of colored goods, the dyes used are especially intended to give effects which might lead a customer to suppose the goods were made of wool, and colors which will not take well on cotton are avoided. Of course, it is not to be supposed that those who buy and sell the goods are deceived, unless it may be among the small dealers; among those who wear the goods, however, we doubt whether one in fifty would acknowledge wearing undergarments made of cotton alone, and most of them would be extremely indignant at having this fact brought home to them, although every manufacturer knows that hardly one in fifty of those who wear these goods have garments with any appreciable proportion of wool in them.

* Marten's "History of Cohoes."

COMPRESSED AIR IN COAL MINING.

The only mechanical coal digger that ever obtained a foothold in the great Pittsburg coal fields is that now at work in the mines of Henry B. Hays & Bro., near the city named. Its use is regarded with such disfavor by the miners as to warrant the supposition that as a digger it is a practical success. This machine is driven by compressed air, and is a recent invention of Mr. M. H. Lechman, of Columbus, Ohio. In appearance it resembles a Woodworth planer placed low upon the ground and borne upon small wheels running on rails. The mission of the Lechman machine is not, strictly speaking, to mine coal, but to "bear in." This operation by the ordinary method requires the miner to assume a most trying position in order to properly undermine the overhanging mass of coal, which is afterwards dislodged by wedges. Two and a half feet is the extreme "bearing in" distance by hand, and to accomplish this reduces a large amount of coal to an unmarketable state.

The construction of the machine in question is peculiar. The oblong steel frame is double, and capable of elongation, like the joints of a telescope. The forward end of the sliding portion bears a cutter shaft similar to that of a planer. This shaft is armed with serrated cutters resembling in action and form the cutting arrangement of a moulding machine. The shaft bearing these cutters is revolved by means of an endless chain taking power from the driving shaft located across that end of the machine furthest from the cutters. The shaft is driven at 700 to 1,000 revolutions per minute by a pair of upright cylinders located one on each side of the machine. These are 5 inches in diameter and 6 inch stroke, taking air at 60 pounds. Being brought with its forward end against the face of the coal, and 1 foot from the bottom—to clear the stratum of "ground coal"—the machine is ready for action. Air being turned on the cutter bar soon dives out of side as the sliding portions of the digger are moved forward by a suitable screw feed. The cut made is 4 inches deep—perpendicularly—3 feet wide, and extends into the coal seam 5 feet. This cut has been made in four minutes, but usually occupies ten minutes.

Suitable scrapers attached to the endless chains clear away the coal dust produced. When it is considered that a day's work for two able-bodied miners is the "bearing in" 2½ feet across 15 feet of coal, the relative speed of the machine undermining to twice the depth of the miner's pick will be noted. As an offset to this is placed the weight, first cost, and subsequent repairs involved by machine labor. The Lechman machine weighs nearly a ton, costs $500, and needs frequent repairing. The Pittsburg coal seam is a trying test, however, inasmuch as the 4 inches taken out by the cutters includes a double strata of extremely hard slate overlying the bottom or ground coal. As compared to the pick the action of this machine is as the saw to the ax in the felling of a tree or the cutting of a log. There would seem to be a wide field for inventive genius in the matter of a mechanical device that would be free from the objections noted above, and that would not require the conveyance of power from a distance to the cutting device.

EMAIL INK.—The drug house of Louis Muller, in Leipsic, has put on the market colored inks which may be used for writing labels on glass, porcelain, ivory, marble, mother-of-pearl, and metal. The writing is done with a goose-quill, and, when dry, adheres so firmly that it cannot be removed by any liquid. Four different colors are made—black, white, red, and blue.—*Drog. Zeit.*

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