formed by these huge machines. They are used for transferring heavy freight from vessels to the docks and from the docks to vessels, for placing boilers and machinery in steamers, for lifting and carrying blocks of granite and artificial stone for engineering works, and for handling other bodies too heavy and too bulky to be handled by other means.

The derrick is carried by a large rectangular float well braced and stiffened by trusses. The tower which supports the king post and booms is about sixty feet high, and is built of large timbers well framed and bolted together. The boom is supported by a number of diagonal rods which converge near the top of the king post and are secured to it by heavy forgings which straddle the iron cap at the top of the post. All of the hoisting machinery is placed on the float under the tower and controlled by the engineer.

IRON LIGHTHOUSE FOR MEXICO.

The Keystone Bridge Company, of Pittsburg, are putting the finishing touches to an iron lighthouse ordered for the Mexican Government by Don Vincente Riva Palacia, late Minister of Public Works of the Mexican Government. The work was carried on under the Supervision of Don J. Ramon de Ibarrota, Engineer to the same government. The structure presents an unfamiliar sight to the inhabitants of the smoky city, rearing its graceful proportions high into the air near the banks of the Allegheny River. When completed the lighthouse will be taken apart, shipped by rail to New York, and thence by sea to the mouth of the Tampico River, where the structure is to be put up.

This house is a skeleton structure, made up of seven series or stories of cast iron columns, braced and tied by struts and tie rods, the whole arranged about a central stair cylinder of cast iron, so as to form a hexagonal tower, 146 feet 7 inches high from weathercock to base. The latter is 46 feet in diameter, tapering to 18 feet 10 inches at the lantern room. The lantern and revolving apparatus are awaiting the lighthouse at Tampico, having been made for this structure at Birmingham, England. Just below the lantern is the "service room," for the use of those in charge of the light. This space is roofed with the castings forming the floor of the lantern room, and a neat railing surrounds the hexagonal space embraced in this floor.

The "stair cylinder" forming the central portion of this lighthouse is of cast iron, 7 feet diameter and ½ inch thick, and composed of 14 sections, bolted at the joints through flanges. The spiral stairway inside the cylinder comprises 173 cast iron steps, spaced by six landings, at each of which a window is let into the cylinder. The weight of this whole structure is 150 tons, and its cost at Pittsburg about $15,000. Another will be built for the Mexican coast by the same firm.

Before taking down the lighthouse its stability was thoroughly tested. A pressure was brought to bear against one side equal to a wind strain of 40 pounds per square foot. The area so subjected being 360 square feet, the test was equivalent to 1,800,000 pounds wind strain needing to upset the structure. The momentum of the lighthouse to resist this being 1,840,000, the surplus in favor of stability was still 40,000, and this without any anchorage whatever.

Prosperous France.

France is affording fresh proof that she is one of the most wonderful nations on the face of the earth. The disasters of the Franco-Prussian war, and the payment of five milliards of francs as the further penalty for entering upon that war, would have crippled an ordinary nation. But France is not an ordinary one, and the result is that she has not only cast off her burden, but contemplates an outlay in internal improvements such as the most prosperous country could alone entertain. It will be remembered that M. de Freycinet, the new Prime Minister of France, before leaving his old department, drew up an elaborate report embodying a gigantic scheme for the creation, extension, and union of railways and canals throughout the country. The estimated cost of these improvements is nine milliards of francs, or £360,000,000 sterling; but France is not deterred thereby, and in twelve years the scheme is to be worked out in its entirety. Already France is noted for the completeness of her railway system, which, with her rivers and canals, afford a means of communication apparently leaving little to be desired; but she is impressed with the belief that improvement is possible, and she is going to add 16,000 miles to her railways, and 900 miles to her rivers and canals. This fresh burst of enterprise on the part of France can have but one effect, and that is increased prosperity in the great industries already stirred into activity by the demands of India, America, and the colonies. Rumor is already busy, says our excellent English contemporary *Capital and Labor*, with the names of English firms about to contract with the French Government, while the iron and steel trades in America and Belgium must also benefit.

Interesting to Patentees.

Senator Hoar strongly advises patentees not to spend their money in trying to get their patents extended. He says that experience shows that no bill for the extension of any seventeen year patent can pass Congress. The feeling against the extension of patents is very strong. Bills have passed one house or the other, but they are always beaten in the end. He says that if he had a brother who had a patent worth $50,000, he would not advise him to spend $1,000 to get it extended.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

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WORK AND WAGES.

We have been surprised that the volume published a few months since by the National Government on the "State of Labor in Europe," has not received more general attention than it seems to have attracted. The statistics, as furnished by the various United States consuls, purport to cover the rates paid for labor in all the leading industries, together with the cost of living in Great Britain and in nearly every country on the continent of Europe. Elaborate tables are also given comparing the averages thus obtained with the rates of wages paid and the cost of living in this country. In addition to the above, our accomplished Secretary of State, who himself obtained the home statistics relative to labor and the cost of living, carefully edited the volume, and, in an extended introduction, gives us a synoptical résumé of its contents, together with some general conclusions of his own.

Now every one will concede that Mr. Evarts, with his wide and varied culture, is a close reasoner, and there is hardly a subject of general interest on which he cannot write or speak so as to command the attention of all thinking men. In treating of this subject, however, it may well be doubted whether he does not carry his generalizations much too far; for, certainly, the tenor of his whole discourse is to point out that our workingmen must accept lower wages in future. The mechanics and artisans in the housebuilding trades, and in every local as well as general occupation, must, according to his argument, in the near future be content to accept for their remuneration wages more nearly approximating to those obtained by European workingmen. The principal ground on which this reasoning is predicated lies in the much higher rates per day now paid to American workingmen, which, the Secretary argues, cannot be permanently maintained when we are exporting largely of domestic manufactures, in competition with the products of the cheap labor of Europe; yet, in another place, he says: "The average American workman performs from one and a half to twice as much work, in a given time, as the average European workman." It is quite a different thing, as every employer knows, to compare the wages per day or hour of different sets of work men, from what it is to estimate the cost of labor under differing circumstances, as shown in the completed work. The former method is the one generally adopted by those who talk or write on the subject; the latter must control the operations of all who succeed in every line of business. The English workman who receives the highest average wages in Europe comes nearest to doing as much as the American workman, but on the Continent, where wages are lowest, so also is the quantity and quality of the work. The consul at Leipsic writes that "an active American workman will do as much work in a given time, at any employment, as two or three German workmen," and the volume abounds with such remarks, which do not put the case a whit more forcibly than we have often heard it stated by American manufacturers who have investigated the matter in personal visits to foreign workshops. The fact is, in making comparisons of this kind, so many things have to be taken into consideration to make the conditions equal, that they seldom give one more than an approximate idea of the situation.

But if it is inevitable that we are to have a sort of leveling process in the rates of wages in "the world of educated and progressive labor," why is there not good reason to suppose there will be some "leveling up"? The average rates of labor throughout Europe have advanced from 25 to 30 per cent since 1850. The upward movement was checked when the speculative era following the Franco-German war reached its climax, and since then, contemporary with the extreme depression which was felt here from 1873 to the commencement of 1879, all branches of productive industry have been undergoing a severe strain. This, however, has not caused any very material reduction in the rates paid for labor, and with the first indications of returning prosperity it is probable that wages will at once be advanced in proportion there, as they already have been in many kinds of business here. A great improvement in trade and manufactures has already been experienced in England, notwithstanding the general failure of the crops there the past year, and, although Mr. Evarts' conclusions were formed eight months ago, we have yet to see the evidence that any considerable number of English workingmen are "sorrowfully standing between their idle factories and the emigrant ships."

COTTON SIZE AND COTTON SIZING.

Not long since we had occasion to notice a legal trial in England in which the work of the professional cotton sizer played an important part. From the evidence which the judge required to be given in open court, it appeared that it was a common thing for English cotton goods to be loaded with size, so as to double their natural weight, while in some cases the fiber carried two and a third pounds of size for every pound of pure cotton. In commenting upon the case the judge said that the manufacturer and the warp sizer had entered into a conspiracy to defraud the public; and to the American mind that seemed a fair description of the transaction. English manufacturers and traders, however, do not so regard it.

We have before us a large and well made octavo volume of some three hundred pages ("Sizing and Mildew in Cotton Goods." Manchester: Palmer & Howe), about half of which is devoted to the art of sizing. Its authors are three Manchester chemists of good repute; and in a letter commending the work to our favorable notice, the publishers assure us that this is the first time the subject has been 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	35·83
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.*