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AMERICAN INDUSTRIES—No. 82.

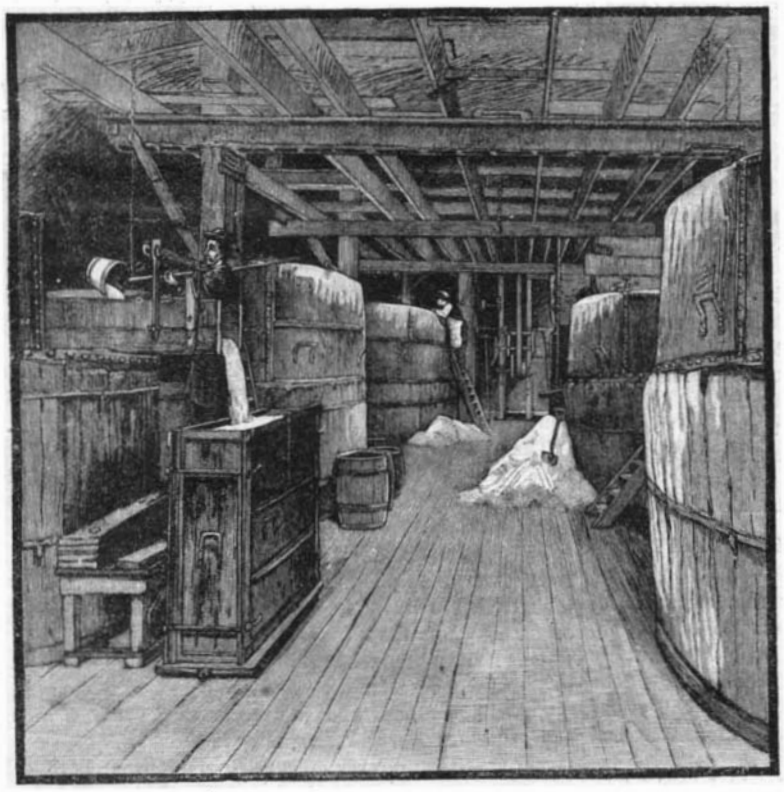
THE MANUFACTURE OF SOAP.

The old folks who were "raised" in the country will at once recognize the scene so cleverly depicted in our first illustration. It is the family soap making—something which is almost a thing of the past. Home-made soap has gone with home-made candles. The only good feature about it was that the housekeeper "knew what it was made of." It was rarely a success; it was either a soft, "putty-like," greasy mass, that had no effect, as far as cleansing goes, or else it was so strong with lye that it reddened and burned the skin in using it, and undoubtedly was as responsible for the holes in clothing as the actual wear, for the over-strong lye attacks the fiber. The modern housewife buys her soap ready-made. She generally buys a certain kind, either because it looks attractive, smells nice, or seems cheap; but, generally, because the grocer recommends it. Why he should recommend one kind more than another may be laid to the score of profit—"that which pays best, sell most of" is his motto. The reason the grocer does not recommend soap that has lasting qualities is because his customers would use less soap, so would not patronize him so often. She should use her own judgment, remembering that "the best is the cheapest;" for, next to our eating, drinking, and clothing, soap is the most important of all the thousand-and-one things that go to make up the sum of our every-day life. That the public may know something about soap-making, this article is written, in a plain, untechnical, and, it is hoped, interesting manner, aided by a series of engravings, illustrative of the process of manufacture used by the well-known firm of Procter & Gamble, Cincinnati. The earliest mention of soap—outside the Bible—is by Pliny the Elder, twenty-three years after Christ. He says that soap made of tallow and wood ashes was the invention of the Gauls. The Romans considered soap to be of Celtic invention. The inhabitants of Pompeii possessed at least one complete soap-boiling establishment, which, when brought to view after having been buried more than 1,700 years, was found to contain soap still in a state of preservation. To the Germans must be given the credit of first manufacturing both hard and soft varieties of soap, hence the propriety of Procter & Gamble calling their famous laundry soap "Mottled German Soap," or, more properly speaking, the "Original Mottled German Soap."

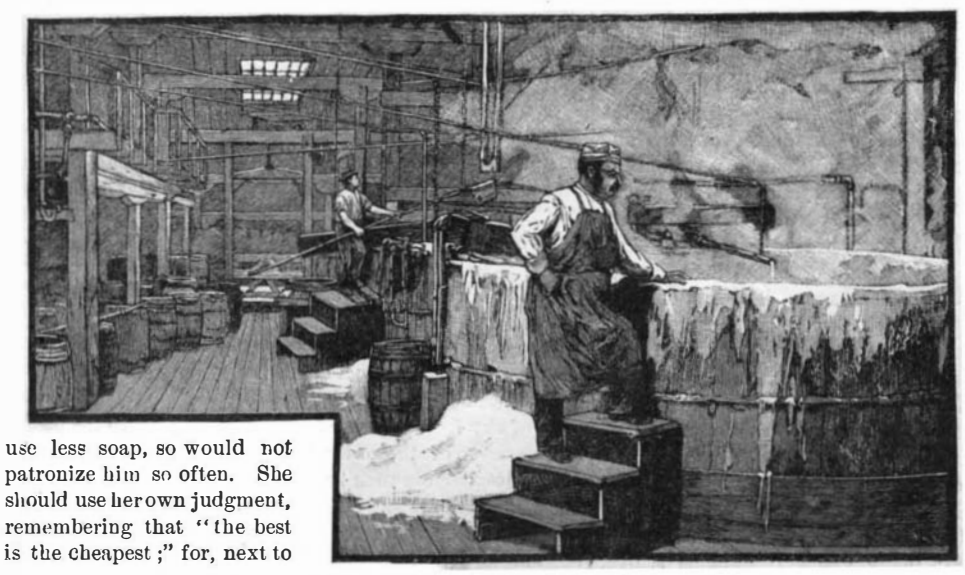
"Pure hard soap is a chemical combination of soda and fat (oil), mingled under conditions favorable to their union." That it may be understood just what constitutes "favorable conditions," and how necessary it is to have an intelligent supervision over

[*Continued on page* 99.]

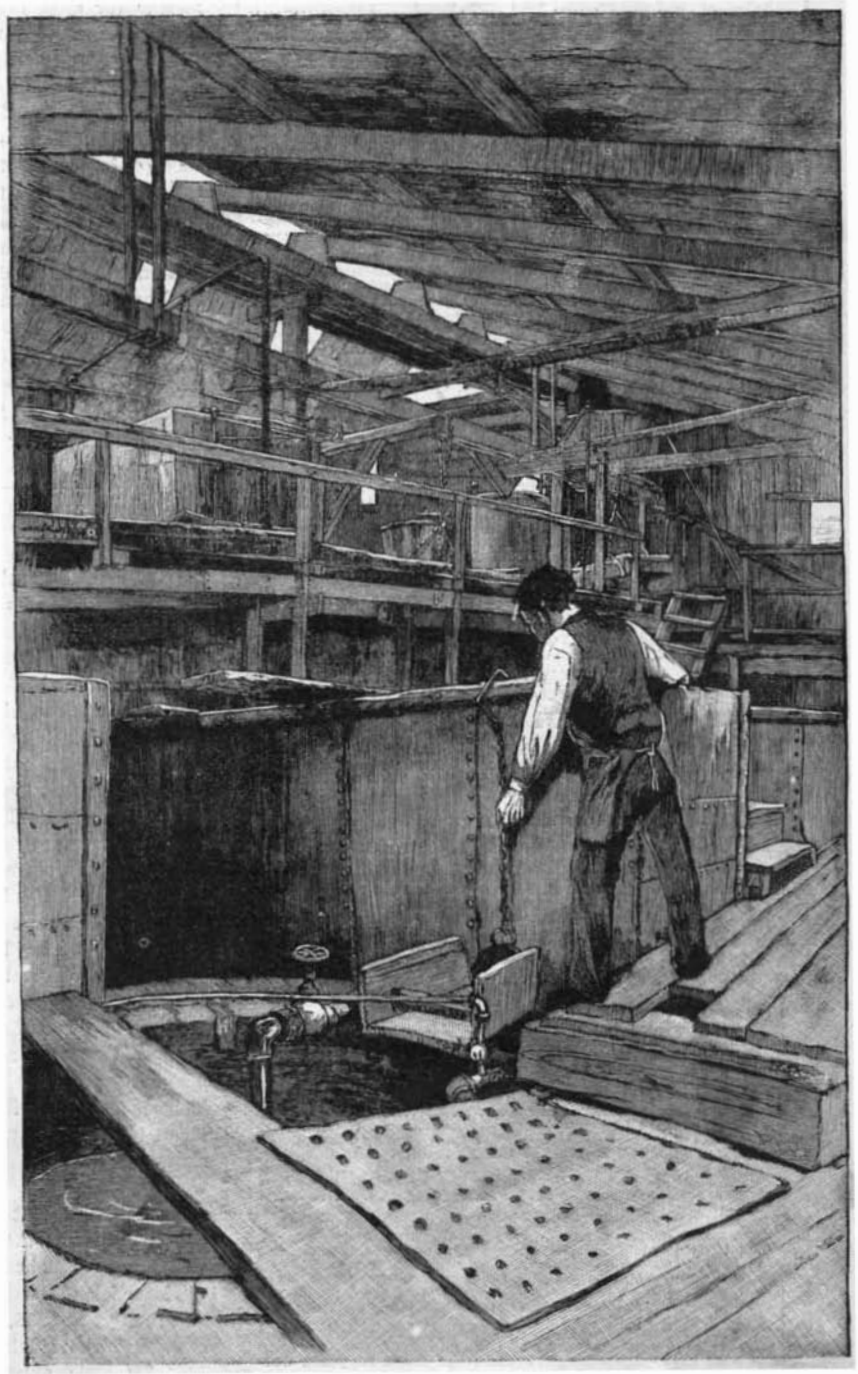
SOAP MAKING.—THE OLD METHOD.



DIPPING THE SOAP INTO FRAMES.



BOILING WITH ALKALIES.



MAKING LYE.

THE MANUFACTURE OF SOAP.—FACTORY OF PROCTER & GAMBLE, CINCINNATI OHIO.

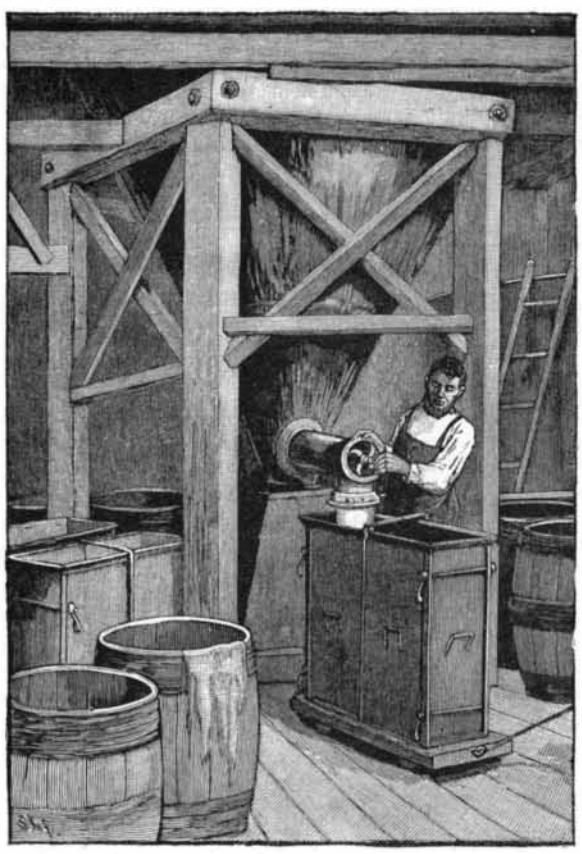
THE MANUFACTURE OF SOAP.

[*Continued from first page.*]

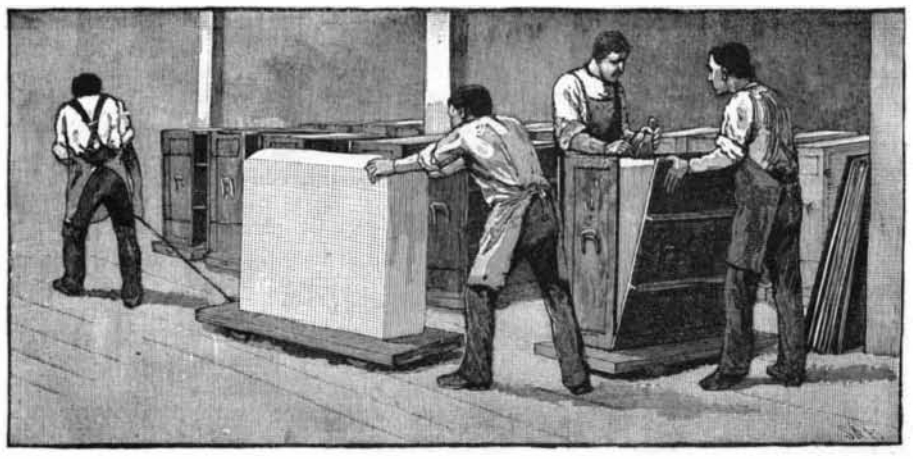
every detail of the process, we shall further along describe the methods pursued in making the best known hard soap.

In soap making, as in everything else, the best results are obtained only by the use of the best materials and most approved methods, combined with long and intelligent experience. Now for the materials. The basis for all soaps is either grease, tallow, or oil—grease being the least desirable, as it does not yield as good soap as tallow or oil. The latter is far superior to either of the other two. Grease is made from the fat of animals that have died, the refuse of kitchens, and other offal. Tallow is made from the fresh fat of sheep and cattle, so is not so objectionable or dangerous as grease. Oils suitable for soap are palm, cocoa nut, cotton seed, olive, and saponified red oil, the latter being especially desirable for laundry soap, as strength and durability are required. Genuine mottled German soap is made of saponified red oil only, which is superior to other "soapers'" oils, inasmuch as it is what is known as a chemically "free" oil; it readily takes hold of the alkali, and the result is a complete saponification, so a complete soap. It is hard even when fresh; there is little or no loss in weight by shrinkage, so the purchaser receives the full amount of soap for his money; that is, he does not pay for water at the price of soap. To the vast manufactory of Procter & Gamble, in Cincinnati, we go for our illustrations and our description of their process, for there the most recent and most perfect of scientific and mechanical appliances are kept at work, and the latest of scientific research is constantly utilized. Every step of the process, from the time the tallow from which the red oil is made is deposited in the emptying room until the soap is packed in boxes and sent to all parts of the country, is full either of interest to the student or entertainment to the simply curious.

As before mentioned, this firm make their mottled German soap of saponified red oil. That the reader may know what this oil is, we must first repeat the statement made in a former article, that Procter & Gamble are the largest manufacturers of candles in the country, and they obtain their materials for making candles from their process of making the oil for their soap. The combination of the two industries is essential to the successful and economical production of both. The first step is the saponifying of the tallow; it is accomplished in an apparatus called, in chandlers' parlance, the "digester," of which there are three in operation. (See illustration, p. 383, vol. xlv., SCIENTIFIC AMERICAN.) It consists of a copper cylinder, inclosed within an iron one, and a pump arranged to raise the contents of the inner cylinder from the bottom to the top. Into this the tallow, which has been melted out of the barrels by steam, is run, and is mixed with lime and water. This mixture is kept up to the intense heat of 600° Fah. by steam, which is let into the outer cylinder at a pressure of 250 pounds to the square inch. The water, being the heavier, sinks to the bottom of the copper cylinder, whence it is pumped and thrown on a perforated plate above the tallow, that it may fall through it in many little streams. This agitation is kept up for eight or nine hours, after which it is found that the lime has united with the tallow and formed a lime soap, while the water has consorted with the impurities, etc. The intense heat to which the tallow is subjected, and the continuous washing it undergoes, destroy and remove any impurities liable to produce disease there may be in the tallow, which of itself gives the Procter & Gamble soap an immense advantage over all others, for it insures to the consumer a soap absolutely pure. No other firm exercises the same amount of care in preparing the "stock" for the boiling kettles, for the ordinary method is to empty the tallow or grease, from which none of the impurities has been removed, direct into the boiling kettles, and the process of manufacture usually pursued is such as to simply warm into life any germs of disease there may be in the grease or tallow. The contents of the cylinder, after being allowed to remain at rest for a time, separate into two strata, the lime soap on top, the impurities and water below. These are blown off into separate vats by the power of steam. The cooling of the lime soap is a slow process. It is run into shallow pans, lined with enamel, and permitted to remain in a warm room two or three days. When it becomes hard, the cakes are emptied from the pans, and wrapped in heavy woolen cloths, and piled into hydraulic presses between iron plates, and the pressure applied. A dark oil gushes from the woolen, pours over the edges of the plates, and is caught by troughs conveniently arranged, from which it is conducted by iron pipes to the soap kettles. This oil is known in commerce as saponified red oil. The preparation and purifying of the lye by this firm are the most thorough known, and insuring the removal of all foreign deleterious matter. The highest grade of carbonate of soda is imported by them direct from England, from which they completely remove the carbonic acid by placing a large quantity in an immense iron tank filled with boiling water, and the entire mass kept hot and agitated by jets of steam. When the solution is complete, the hot liquor is drawn out upon a shallow iron tray having a perforated bottom. This tray contains a certain quantity of lime, and is suspended within and near the top of an iron tank, placed on a lower level than the first tank. The hot soda solution falls through the tray into the lower tank, carrying the lime with it. After being agitated, the lime settles to the bottom, carrying with it the carbonic acid and all impurities. After being allowed to settle sufficiently, the clear liquor, which is lye in its purest form, is drawn off into the soap kettles, leaving the lime, etc., in the tank. It will be seen that everything that has thus far gone into the soap kettle has been thoroughly purified and cleansed, all of which Procter & Gamble have found necessary to have done under their own supervision to insure having it honestly performed, on the principle, "If you want anything well done you must do it yourself."



FILLING THE COOLING FRAMES.

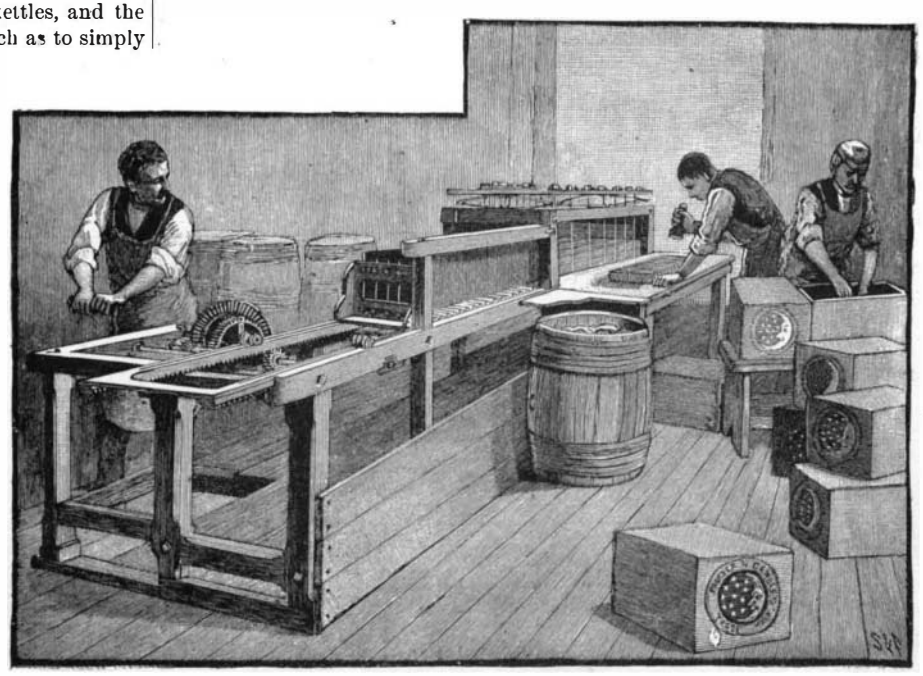


STRIPPING THE FRAMES FROM THE SOAP.

The soap kettles are large cylindrical vessels made of boiler iron, open at the top and having a conical bottom. They are heated by means of iron steam pipes coiled into an inverted cone to correspond with the shape of the bottom. Another coil or single ring of steam pipes is placed near the bottom and perforated with numerous holes; this latter is termed the "open steam" or "blow" pipe, and the former the "close steam pipe." They are used at different stages of the boiling, to effect a thorough mingling and heating of the materials. There are pipes leading from the bottom of the kettle for the discharge of the "spent lye," and a large pipe near the bottom, through which the finished soap is drawn directly into the cooling frames, as shown in the illustration. A part of the side of the kettles at the top is arranged to be removed, to facilitate "dipping" the soap into frames. This method of emptying the kettles is adapted to thick soaps, which cannot be conveniently drawn from the bottom.

Now for the boiling process. A quantity of the lye, prepared as described, is allowed to run into the soap kettle, and when heated by steam is ready to combine with the oil, which is allowed to flow gradually upon the lye; more lye is added from time to time, as may be required, until, the oil having combined with the soda, the whole has become a uniform mass of neutral or weak soap, dissolved in the water which had contained the soda. Salt is then freely scattered over the surface of the soap, and as it descends through it, it becomes dissolved in the water. This heavy solution precipitates to the bottom of the kettle, while the lighter soap, insoluble in salt water, floats above. This salt water, or "spent lye" as it is termed, is drawn off below. Repeated additions of lye, as mentioned before, are made, and after boiling and salting out, are drawn off, until the soap has become sufficiently strong, or, in other words, completely saponified. It is then purified by running into it a quantity of water, which has the effect of thinning it, so that any chance impurities and any excess of lye, after sufficient time has elapsed for settling, may be drawn from the bottom of the kettle, a very complete and distinct separation having been effected.

The value of washing out the surplus or "free" lye cannot be overestimated, for the free lye would attack the fiber directly, and thus burn or rot the clothing; it will also change the color and make white goods yellow, and burn and redden the hands. After boiling for a period longer, to evaporate the surplus water, the soap is then ready to be dipped over the side of the kettle or drawn from the bottom through a large pipe closed by a valve easily moved by a wheel. The cooling frames into which the soap is thus conveyed are iron boxes with wooden bottoms. These bottoms are provided with wheels, that the frame may be drawn to the proper place for filling, or cooling, or cutting. When the soap is sufficiently cool (from four to six days) it is "stripped," that is, the bolts which clamped the sides against the ends are withdrawn, and the sides and ends removed, leaving the cooled solid soap standing upon the bottom. It is now ready for the cutting machine. The cutting is done by wires drawn through the soap horizontally. This changes it into slabs the width and length of the frame and two or more inches thick. These slabs are placed, five at once, upon a "barring" table, where, by means of a small cog wheel made to revolve under a rack, the slabs are forced against and between wires kept taut, and are thus divided into long bars. By a slight change of a shaft, the soap cutter is enabled to push the long bars sidewise against another set of wires, which divide them into short or one-pound bars. The wires are set with perfect exactness, so that all the bars are of the same size and weight—one pound each. After being stamped by hand, the soap is packed into boxes that have the weight of the box marked on each. Then each box of soap is weighed, and the exact net weight is marked upon every box, and the soap is now ready for market. It will be seen that the cutting, stamping, and packing are simple and inexpensive; the useless expense of pressing into fanciful shapes and wrapping in bright-colored papers is saved. The public pay many thousands of dollars every year for pressing and wrapping soap, that are of no benefit to the soap or to them; in fact, it is done in most cases to make a poor article look attractive and more salable; the old-fashioned square-cut bars are the most economical.



CUTTING, STAMPING, AND PACKING SOAP.

One leaves the works of Procter & Gamble fully impressed with the fact that they know the wisdom and value of "what is worth doing at all is worth doing well." The thoroughness with which everything is done in the production of

their mottled German soap shows careful and intelligent attention of skillful men, and the soap itself, being made by the most approved method and of the best of materials, thoroughly refined under their own supervision, is the very perfection of laundry soap, which water cannot penetrate and weaken, so that the last small piece is as good as a new bar; there are no acids or excess of alkali to injure the skin or clothing; in short, it is what all laundry soap should be—effective, durable, and economical.

A good article that has achieved success is always imitated, so it is but natural that there should be many imitations of Procter & Gamble's soap. The so-called mottled German soaps are made principally of grease, though some contain a small percentage of red oil, simply as an excuse for calling them "red oil soaps." They owe their mottled appearance to the impurities which are suspended in the soap; they are more or less offensive in odor on account of being made of grease. The process by which many of these so-called mottled German soaps are made is known as the "cold made" method, that is, the grease and lye are mingled together at the very moderate temperature of 110° Fah. There is some chemical action, but the result is strong in alkali, and at the same time greasy to the touch, and will not produce an abundant lather; the alkali not being thoroughly combined, but "free" to a great extent, will attack the fiber and burn the skin. Water will easily penetrate them, weaken the alkali, it being "free," and thus render the compound a greasy, putty like mass. There are many soaps of a pale straw color, very clear about the edges, and having the appearance of being made of wax. They are really very attractive in appearance, much more so than mottled German soap, which is, it is true, "homely but honest." Most of these clear soaps are made of tallow, and contain a large percentage of rosin and water. They shrink as they grow older, so, in order to preserve their shape, a considerable quantity of sal-soda is incorporated in them. The effect of this is that the excess of soda will eat or rot anything that has been washed with the soap.

The reader can form no idea of the vast number of compounds that are given to the public under the name of soap. Fully nine-tenths is not what the buyer has a right to expect. The materials used are full of impurities, and are too often made of decayed and putrid matter. Chemical science has shown how the noxious smells may be prevented, by the use of acids, etc., and by a plentiful addition of rosin to cheapen them, and perfume to hide the natural odor, they are passed out upon the unsuspecting purchaser. Fancy having your handkerchiefs, napkins, towels, and clothing washed with these compounds; yet there are many who will pay from ten to seventy-five cents for a small cake of toilet soap, but think anything is good enough for the laundry. A little more attention to the soap used in the laundry would insure greater healthfulness. When the pores of the skin are open by perspiration, the condition is favorable to absorbing into the system any impurities in the soap which the laundress may have failed to thoroughly rinse out of the garment, owing to the greasy and sticky condition of the soap used. Cases of fevers and diphtheria have frequently been traced to the use of soaps made of unfit materials, and cases of skin diseases without number to the same cause.

Not content with using poor materials, many soap makers use what are known as "make weights;" these are for the purpose of increasing the profit of the manufacturer, without equivalent value to the consumer. The principal "make weight" is marble dust, which costs but sixteen dollars per ton, or less than one cent per pound, so it is easy to see that the profit of the soap maker is greatly increased; for with three-quarters of a pound of soap a quarter of a pound of marble dust may be incorporated, and the compound sold as a pound of soap. Another adulterant is the "magnesia drier," which, in addition to being a "make weight," will help retain a large amount of water in the soap, and thus enable the manufacturer to sell water at the price of soap. A large volume might be written upon the adulteration of soap alone, but the brief description of soaps given in this little sketch is sufficient to enable the intelligent buyer to discriminate in favor of the best.

Awards to Workmen for Inventions.

The scheme of awards for inventions, instituted in August, 1880, by Messrs. William Denny & Brothers, shipbuilders, Dumbarton, and which has been regarded with considerable interest by very many employers of skilled labor, has just been amended and reissued to the workmen in their establishment. The results of the scheme as regards the number of workmen making applications or claims for inventions or improvements have been thoroughly satisfactory. The number of claims found valid, and the important nature of some of the inventions or improvements for which awards have been granted, have been such as to encourage Messrs. Denny to amend their scheme in one or two particulars whereby it may be rendered more effective. The maximum limit of award as laid down in the original scheme was £10; but it has been thought that the smallness of the sum may deter some from coming forward with ideas or with matured inventions of greater technical importance or value than have yet been elicited. Accordingly, Messrs. Denny and the committee of awards acting between employers and employed in this matter, have made a revised scheme wherein the fixed maximum limit of award is supplemented or superseded by the inducement of either (1) the granting of a greater award than £10, or, if considered worthy, (2), the award of £10, together with material assistance in securing letters patent for the invention. The following are the principal rules or features of Messrs. Denny's first scheme: 1. Any workman in our employ may claim an award from the committee on the following grounds: (*a*) That he has either invented or introduced a new machine or hand-tool into the yard. (*b*). That he has improved any existing machine or hand-tool. (*c*) That he has applied any existing machine or hand-tool to a new class of work. (*d*) That he has discovered or introduced any new method of carrying on or arranging work. (*e*) Or, generally, that he has made any change by which the work of the yard is rendered either superior in quality or more economical in cost. 2. In the case of a workman who is unable to test the merit of his supposed invention or improvement, either through inability on his own part to make the necessary experiments or to pay for the same, the firm, on the recommendation of the committee, may agree to bear the whole, or part, of the necessary expense; and if the invention should afterwards prove a practical success, an award will be granted accordingly. 3. On the establishment of a claim under the conditions above specified, the committee are to make an award, which is not to fall below £2, nor to exceed £10. Between these limits the award will be fixed by the committee according to the opinion they may form of the value of the improvement or invention for which claim has been made.

The clauses in Messrs. Denny's second scheme, embodying the changes in question, are as follows: 2. In the case of a workman who is unable to test the merits of his supposed invention or improvement, either through inability on his own part to make the necessary experiments or to pay for the same, the firm, on the recommendation of the committee, may agree to bear the whole, or part, of the necessary expense; or the committee will be at liberty to grant the free use of tools and appliances in the yard for this purpose, and if the invention should afterwards prove a practical success, an award will be granted. 3. On the establishment of a claim under the conditions above specified, the committee are to make an award, which is not to fall below £2, nor to exceed £10. Between these limits the award will be fixed by the committee according to the opinion they may form of the value of the improvement or invention for which claim has been made. But in the case of an invention or improvement being considered by the committee worthy of a greater reward than £10, they shall submit a report on the same to the firm, who may sanction either (1) the granting of such greater award than £10; or (2) should the invention be considered worthy of being protected by patent, an award of £10, together with the taking out at the firm's expense of provisional protection at the Patent Office on behalf of the inventor, all with a view to enable him either to dispose of his invention during the period of protection, or to make arrangements for completing the patent at his own or his friend's expense, provided always, that the firm shall have for all time coming the use of any such invention so provisionally protected at their expense, free from the payment of any royalty or patent rights that may be chargeable on the same, should the patent be completed.

Messrs. Denny & Co. Engineers, Dumbarton, have also, but for the first time, made offer of awards for invention to their workmen, and the scheme is in all respects similar to that just issued to Messrs. W. Denny & Brothers' workmen. The results of this renewed effort on the part of Messrs. Denny to quicken the inventive faculties and increase the technical proficiency of their workmen are sure to be waited on with interest. It is to be hoped, says *Iron*, that such measures may be productive of the good, which, in some quarters, is only hoped for through the increased institution of technical schools; and that the advantages accruing to the business of the firms in which the system has been introduced may speedily be such as to lead to its adoption in other places.

The Water of a Holy Well.

Professor Frankland has recently sent a letter to the London *Times* on the quality of a well regarded as sacred by Mohammedan pilgrims. The water appears to be even worse than that of many wells not considered sacred, but we hope our readers will take warning from this extreme instance of well pollution, and consider that it does not require contamination seven times worse than sewage to send typhoid and cholera into the houses of Christians, however it may be with Mohammedans.

Professor Frankland says: "The well is in Mecca; the water is regarded as holy, and large quantities are annually sent as gifts to all Mussulman countries. Most of the Mohammedan princes, especially those of India, have 'keepers of the well,' whose duty it is to send them annually water from the well.

"I have analyzed this water, and find it to be of the most abominable character. In fact, it is sewage more than seven times as concentrated as London sewage, and contains no less than 579 grains of solid matter per gallon. Knowing the composition of this water, and the mode of propagation of Asiatic cholera by excrementitious matters, it is not to be wondered at that outbreaks of this disease should often occur among pilgrims to Mecca, while it would scarcely be possible to provide a more effective means for the distribution of cholera poison throughout Mohammedan countries."

Mutilated Coins.

The Director of the Mint has authorized the purchase at the several mints at Philadelphia, San Francisco, Carson, and New Orleans, of mutilated and uncurrent United States silver coin of standard fineness at the rate of $1 per ounce Troy, when presented in sums of $3 and upwards.

Coins can be forwarded to those mints by registered mail or by express, charges prepaid, and the value will be returned at the seller's risk and expense by express, registered mail, check, or draft. Persons sending full weight United States subsidiary silver coins would receive, at the rate authorized, 80 cents per dollar of their face value, but, for mutilated coins, a less amount, proportioned to the deficiency in legal weight. At the rates paid mutilated silver coins will be worth at the mints: Per ounce troy, $1; per ounce avoirdupois, (about) 91 cents; per dollar, face value (approximately), 70 to 76 cents.

AGRICULTURAL INVENTIONS.

An improved harrow evener has been patented by Mr. Hermann H. Fischer, of Osage, Neb. The object of this invention is to promote convenience in harrows of collected rubbish, and in adjusting them to harrow the ground fine or coarse.

An improved corn planter and fertilizer distributer has been patented by Mr. William Cassill, of Hamden Junction, O. The object of this invention is to facilitate the simultaneous dropping of corn and distribution of fertilizers.

Mr. Abraham C. Scarr, of Maryborough Township, Ontario, Canada, has patented a harrow having such action that its teeth will not have a tendency to follow the edges of the furrows nor leave narrow unbroken ridges in the soil, but will cut the soil in all directions, causing complete pulverization of the soil and perfect covering of the seed without the necessity of cross-harrowing the field.

An improved grain header has been patented by Messrs. John W. Jory and Arthur B. Jory, of Salem, Oregon. The object of this invention is to remove the heads of the grain and leave the whole of the stalks standing, however much the said stalks may vary in length.

An improved cotton planter has been patented by Messrs. Anthony W. Byers and James C. Dorser, of Sherman, Texas. The object of this invention is to improve the construction of the cotton planters for which Letters Patent No. 233,725 were issued to the same inventors, October 26, 1880. The invention consists in the combination, with the slotted hopper bottom, of hinged and curved cut-offs and spring, whereby the escape of seed will be prevented, except as forced out by the prongs of the feed wheel.

Mr. William R. Berry, of Easley's Station, S. C., has patented an improved cotton planter and fertilizer distributer. In this machine the bearing wheel has peripheral U-shaped teeth, working in and through a slotted hopper bottom, for feeding the material to be sown.

An improved rocking churn has been patented by Mr. Otto Gentsch, of Souderton, Pa. The invention consists in a box provided with a transverse rack, with ice receiving chambers in opposite corners, and with rockets resting on wheels of a base, permitting the box to be rocked by means of its handles, and if the box is to be locked in a certain position a locking pin is passed through an aperture in the rocker into a correspondiug aperture in the base.

American Woolen Manufactures.

Abstract from Incomplete Returns of the Tenth Census (1880) *of Woolen Manufactures.*

	Establishments.	Sets of Cards.	Combing Machines.	Wool. In Condition Received. Foreign.	Wool. In Condition Received. Domestic.	Wool. Scoured.	Shoddy.	Cotton on Cards.	Cotton Warp.	Capital.	Value of Products.
				Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.		
Woolen goods	1,946	5,780	78	20,757,407	176,335,025	109,289.789	49,214,381	28 360,754	16.692,263	$93.911.064	$160,375,300
Hosiery and knit goods	356	615	3	440,758	7,966,137	5.827,692	1,739,947	20,756,151	266,511	15,111,626	28,253.683
Carpets	199	285	155	34,044,252	2,029,319	23,563,215	60,369		6,636,382	29,486,287	33,158,377
Felt goods	26	121	..	721,067	4,192,806	2.671.796	2.456,849	1.131,500		1,958,255	3.619 653
Worsted goods	75	258	281	15,687,815	23 646.511	25,025,235	190,800	1,757,842	5,178,352	20.411,043	33,359.941
Wool hats	41	302	..	1,865,513	6,074,471	3,535,279	1.248,952	185.400	....	3,605.830	8.496.845
All industries	2,643	7,361	517	73.524,812	220,244,269	169,913,007	54,911,298	52,191.647	28,774,109	164.484,105	267.263,799

NOTE BY MR. G. W. BOND.—It will be seen that 73,524,812 pounds foreign, and 220,244,269 pounds domestic wool, as purchased by the manufacturers, yielded to the cards 169,913,007 pounds, which indicates that of the whole wool consumed, at least ten to twelve million pounds must have been in the scoured condition, thus accounting for a consumption of at least 75,000,000 pounds foreign and 230,000,000 pounds domestic, in the usual marketable condition.