

nations consuming the most, and the consumption decreasing in regular ratio through the less cultured and semi-civilized nations to the barbaric. This ratio of consumption is explained on the principle that a luxury follows the means to procure it, and that with increased means there ensues an increased use. Sugar, although classed as a luxury when compared with breadstuffs, meats, and vegetables, has yet become essential to modern civilization through the multiplex uses it has been put to. The sugar industry ranks about seventh among American industries. Following close in importance on such leading national industries as flour and grist milling, lumber, the manufacture of boots and shoes, clothing, cotton and woolen goods, and forged and rolled iron, as determined by the amount and value of their products, it stands next to tobacco and spirits as a special governmental resource, paying into the national treasury, in conjunction with molasses and melada, fully one sixth the total annual revenue levied as import duties.

In the United States the sugar business is both an agricultural pursuit and a manufacturing industry. Louisiana is the largest grower of sugar cane among any of the Southern States, though Texas and Florida swell the aggregate annual yield considerably. These three States during the year 1861 produced more than 191,000 tons of sugar. The pursuit of cane-growing was abandoned during the war of the Rebellion, but after its close was taken up with renewed energy, Louisiana alone producing from 1869 to 1873, 61,863 tons. The principal foreign supply of sugar is derived from Cuba. In fact, the importation from all other foreign countries together amounts to less than half of that imported from the Great Antilles. None of our other imports, excepting bullion, can approach sugar in value or quantity. In the year 1877 the quantity aggregated over a billion and a half of pounds, and had all of it been carried in American bottoms it would have greatly assisted our shipping interests. The large bulk of this trade should be commanded by American ships, because Cuba, Brazil, and Porto Rico, countries which grow nearly two thirds of the world's sugar production, are eager for improved commercial relations with the United States.

The quality of all sugar is determined by the amount of saccharine it contains. The yield of saccharine from sugar cane is much superior to the yield from any other fruit or vegetable. The amount obtained from sugar beets is next to that obtained from the cane, and hardly distinguishable from it when refined. Besides these two sources sugar is derived from dates, sorghum, maple trees, and corn. The latter is called grape sugar or glucose, of which the public has lately heard so much in connection with adulteration. It is produced by the chemical change of the starch in the Indian corn, through the action of sulphuric acid. It contains less saccharine, and is much cheaper than other sugars. There are three varieties of sugar known to commerce and readily determined by experts; *i. e.*, the Muscovado, the clayed, and the centrifugal. The first two are made according to old methods, the last is the modern improvement.

It is the purpose of this article chiefly to consider sugar as a manufacturing industry. Coming as it does in a very crude state from the plantations, intermixed with dirt, sand, bits of cane, fungus, and animalcula infinitely more repulsive than those of our midsummer croton, it has to undergo a thorough refining to throw off all these impurities and yield an article fit for commercial and domestic use. This industry utilizes the services of an army of 15,000 men; profitably employs \$25,000,000 capital; and dispenses in wages \$9,000,000 annually.

To illustrate the methods of sugar refining the establishment of Havemeyers & Elder, in Williamsburg, L. I., has been selected. It is not only the largest, but has the most approved methods of any refinery in operation, although most of the machinery is the same as that adopted by the largest refineries the world over.

The illustrations on the first page, if carefully studied, will impart to the reader as general a knowledge of these methods as though he himself were shown through the mammoth works by the superintendent, as the writer of this article was. It is not intended to portray every little detail of mechanism; that would require a volume. Only the most important machinery is given, such as is essential to the different processes of refining, and illustrating the important steps in these processes.

Such a refinery as Havemeyers & Elder is a world of activity in itself. Each of the many departments has its separate force of laborers, with well defined duties, working toward a common result. One becomes bewildered in the intricacies of their vast buildings. The investigator is taken two stories underground, and eight above. He walks under the street, and traverses in the departments above, 16 acres of flooring. The machines and apparatus illustrated are distributed in various parts of the refinery. Most of these are duplicated many times, and all of them only indicate the magnitude of the rooms in which they are operated.

This refinery, in common with all others, takes the "raw sugar," in all its varieties, and first of all, dissolves this crude article in large mixing vats, one of which is shown in the illustration, entitled "Melting Pan." These vats each hold 2,500 gallons. About 46 parts of water is added at a temperature of 110°, and the small engine, also seen in the illustration, performs the mixing. The raw sugar is pumped up eight stories into the heating tanks, where it is partly clarified by the introduction of an albumen, and 210° Fah. is applied to it by steam pipes running through the bottom of the tanks. If from any cause the sugar is sour, this is cor-

rected by the use of lime water. The heated liquor is run from the tanks, and received into filter bags, arranged underneath, which strain out all dirt, sticks, and coarse impurities. The strained liquor is then run into the bone-black filter, where it comes in contact with the boneblack, and is entirely decolorized. The illustration entitled "Bone-Black Kiln" shows the vastness of the retorts necessary to return the large quantities of boneblack used. At this point the processes diverge for the production of Soft and Hard sugars. In the former the decolorized sugar is taken to the Vacuum Pan, shown in the center of the illustration, and is cold-boiled to a grain from 2 to 6 hours, according to the quality. Valves on the bottom of the Vacuum Pan discharge the grained liquor into large receptacles over the centrifugal machines.

These machines are among the most wonderful modern inventions for expediting the manufacture of Soft sugar. The illustration gives a good idea of them. They consist of a strong steel basket, holding 230 pounds, inside of which is a sieve, and a plate, as finely perforated as one of Edison's phonograph foils. The sieve is between the basket and the plate, to protect the latter. The whole is protected by a solid wrought iron curb, within which the basket revolves with its contents at the rate of 1,000 revolutions per minute, and the centrifugal action forces the sirup through the perforations, which are too small for the passage of the sugar grain, into the curb. Havemeyers & Elder have 32 of these machines in operation. The sugar after undergoing this process is emptied into wagons underneath the centrifugal machine, and dumped into bucket elevators, which run up over a powerful fan, that throws the sugar against a partition near by, and cools and mixes it at the same time, after which the sugar is ready for barreling. The cooling and barreling will be seen in the illustration.

The processes for manufacturing Hard sugar are the same up to the time the raw liquor goes into the Vacuum Pans. It is boiled in a slightly different manner. After running into a receiver from the Vacuum Pans the mass is filled into conical iron moulds, 4 feet in height and 12 inches in diameter across mouth. Each has a hole in the bottom like a flower-pot. The moulds are allowed to stand in the filling room downstairs for 12 hours, with the holes plugged up, so as to allow the sugar to cool a little, and "set." They are then hoisted up into the drying rooms, and the plugs are taken out of the bottoms. They are placed on "bedsteads" and drain. After all the sirup runs off that will, the top of the moulds are brushed smooth, and a saturated solution of white sugar and water is poured on top and percolates through the Titlers (as the contents of the moulds are called), carrying off the remaining sirup. The discolored tips are now cut off, and they are placed into large ovens, heated by steam to 110°, where they remain one week, coming out ready for the crushing, pulverizing, and sawing processes. In the former the Titlers are crushed into irregular shape; in the second, it is finely pulverized; in the saw mill the titlers, which are like columns of granite, are sawed through horizontally into wheels, laterally into strips, and then are chipped into cubes. Illustrations of these processes are shown, and sufficiently indicate the manner in which the titlers are worked up for the market.

Soft sugar, by the use of the centrifugal machine, is refined in twenty-four hours, while hard sugar requires a fortnight.

The establishment of Havemeyers & Elder has an existence of half a century. It employs 1,000 hands, and turns out a million and a quarter pounds of sugar daily. The accusation of adulteration made by certain parties against several of our largest refiners of sugar has, according to Mr. Wells' recent report on the subject, no foundation in fact. Careful tests have been made by the highest chemical authorities, which seem to verify his statement. Furthermore, the establishment described in this article invites the most thorough investigation by any competent authority.

THE BILL TO DISCOURAGE INVENTIONS.

It is doubtful whether any section of the proposed amendment of the patent law (Senate bill 300) was so generally approved by those who appeared before the Congressional Committee on Patents last winter, as section 11; a marvelous illustration, it seems to us, of the proneness of men to clutch at the nearest remedy for a present evil, without stopping to think whether the remedy may not in the end be worse than the disease.

Our readers will remember that this section introduces the principle of cumulative fees, a radical innovation in the working of the American patent system. As we have shown in previous issues of the SCIENTIFIC AMERICAN, the principle is entirely at variance with the spirit of the patent law as it has been interpreted hitherto, and one calculated to work no little harm to inventors and purchasers of patents.

A careful examination of the reasons offered, in Congress and in the Committee room, for making this change, proves them to be in reality but varying statements of one complaint, which was succinctly expressed by Mr. Christy in these words:

"After a patent has got established and become successful, it is a common thing to hunt up similar prior issues, purchase the patents, and, under the facilities afforded by law as reissues, obtain a reissue patent covering what somebody else has invented, and then sue the real inventor. This (section 11) will wipe out at least 75 per cent of that class, and then we will have a great deal less trouble from that law."

The class of patents which Mr. Christy had been speaking of were those which Mr. Raymond had described as "trivial, impractical, and invalid patents," and "those which become of value late in their existence, and then only for the purpose of infringement suits and speculations."

The advantage to be derived from officially killing "trivial, impracticable, and invalid patents," is not very apparent. Such patents must, by their very nature, be dead to begin with, so far as their possible influence is concerned. No inventor of anything that is not trivial, impractical, or invalid, is likely to be worried about them or by them. There remain a small number of patents which become, rightly or wrongly, the occasion of infringement suits and other forms of litigation, the majority of which are reissues of the sort described by Mr. Christy. These are indeed the occasion of much trouble, the desire to get rid of which furnishes the only excuse for the proposed alteration of the law.

How large is the number of such mischief-making patents?

From the noise made in certain quarters one might suppose that a patent was little else than a summons to appear in court to begin or defend an infringement suit. In reality there is no species of property about which there is proportionally so little litigation.

It was shown in the Committee room, by an advocate of section 11, Mr. Chauncy Smith, that 60 per cent of the patent litigation of the country arises upon reissued patents, while the number of patents reissued is not over 4 per cent of the whole number of patents. How enormous, then, is the proportion of patents about which there is no litigation!

There is an old and pertinent story about the killing of a fly with a sledge hammer. The fly was an annoyance, truly; the sledge hammer most effectually smashed the fly. But the avenger had no further use for his nose. Improperly reissued patents, misused for speculative purposes, are flies on the face of the patent system. Section 11 is a sledge hammer, which may hit them. Is it a fit means for accomplishing the desired end?

Mr. Christy and others say that the section will enable us to get rid of 75 per cent of the obnoxious reissues; in other words, three of the four patents in the hundred, which occasion three fifths of the patent litigation. Mr. Raymond says that a similar provision in the English patent laws annuls 75 per cent of all the patents issued. That would be a terrible blow for so small a fly!

An amendment preventing the reissue of patents "covering what somebody else has invented," in other words, more than the original patent included, would seem to be a more suitable as well as more effective remedy.

It is claimed for the proposed amendment that, at its best, or worst, it will do away with not more than three fourths of the vicious reissues; this, at the cost of, let us say, one half of all the patents issued, as the proposed section is not quite so severe in its operation as the corresponding provision of the English law.

Consider the probable effect of annulling, in their early years, one half the patents issued in this country. The majority of inventors are poor men. The majority of those who make important and valuable inventions are poor men. The majority of important and valuable inventions require more than four years, or eight years, wherein to become firmly established and commercially successful. The proposed amendment would therefore discriminate against valuable inventions quite as surely as against the trivial. The nose would be hit severely, though the fly escaped.

Consider the injustice of imposing upon all inventors heavy penalties in the form of fees, which are uncalled for in all cases, and which, in many cases, must be equivalent to the practical confiscation of the inventor's rights, simply because he happens to be poor as well as meritorious. How often it happens that an inventor dies before his invention is financially developed! Shall the United States rob his family of their only inheritance because they are not able to work it up at once, or redeem it by the payment of special taxes?

Consider the impolicy of adding to the discouragements of inventors (toiling, it may be, under privation to develop and persuade the community to use improvements which may be of enormous public benefit) by compelling them to meet such arbitrary and needless demands on pain of forfeiture of their rights.

Consider, too, the door that would be opened by this section for injury to purchasers of limited patent rights, since it would make the permanence of their rights contingent upon the payment of successive fees by the inventor. As the law stands it is safe to purchase a manufacturer's or user's right under a patent for any State or locality, because a patent once issued and approved is unconditionally good for its whole period, and the buyer can estimate its value accordingly. Under the proposed amendment it would not be safe, for the inventor might, through willfulness, carelessness, or inability, neglect or fail to complete his title. The change proposed would, therefore, very seriously diminish the market value of all patented inventions the manufacture or use of which could not be monopolized by one firm, to the serious injury of a large number, perhaps the larger number, of patentees. And it would needlessly increase the risk of all who should undertake a new industry resting on such a precarious footing. Such a law might thus be fairly styled a law for the discouragement of progress in the arts.

Surely it would seem possible for Congressional wisdom to devise some plan for preventing or punishing the evil aimed at with greater certainty and with vastly less cost to the entire community.