AMERICAN INDUSTRIES.—No. 30.

THE MANUFACTURE OF LEATHER BELTING.

The use of leather belts or bands for the transmission of power in driving heavy machinery is a comparatively modern innovation. It was a "Yankee idea," as the phrase goes, and this method of conveying power has been adopted in this country to a far greater extent than anywhere else in the world. In England, whose pre-eminence in nearly all branches of manufacture has always been so marked, the possibility of using leather belts to run heavy machinery was for a long time scouted, and it is only within a few years that some of the largest mill owners there have practically conceded the advantages of this method. To run small machines, where but little power was required, bands made of different substances had long been used, but where a great amount of power was to be employed, cog wheels or gearing was thought to be absolutely indispensable. It was expensive to fit up machinery to run with cogs and gearing; there were many breakages, involving interruption to work as well as costly repairs, and a great amount of power was always lost in friction; but it had become a fundamental idea of the English mechanic that this was the only "sure" method of conveying power in a large way. We have even known of instances, within the past ten years, where owners of extensive factories in England could not believe it possible that machinery requiring as much as 300 horse power could be run without the use of cog wheels or gearing, until the driving power had been several times divided up, and have been witnesses of their astonishment at seeing one leather belt regularly transmit what was estimated as 800 to 1,000 horse power. A large portion of the manufacturers in England and on the Continent of Europe still use gearing for work in which its employment would not be for a moment thought of in this country, but its use is now rapidly giving way before the proved advantages of what may be truly called the American system.

The manufacture of leather belts as a distinct branch of business was first commenced about the year 1825, by a New York leather merchant, who occupied for that purpose the lofts of a store in Ferry street. Previous to that time it was customary for machinists to fit up their own belting, buying the leather in the side or whole hide, and cutting and joining the lengths. As the "stretch" had not been taken out of the leather, the belt so made would constantly need "taking up," and as the hide had not been especially selected for this purpose, and the makers generally knew but little of the differences in the quality of the leather in different portions of the hide, it was seldom that a belt would run true without twisting. When, however, a good mechanic, who had also a tanner's acquaintance with the differences in leather, undertook to manufacture belts, there was not only a wonderful improvement in their wear and the amount of work which small belts would do, but the first step was taken toward so extending their use that they could take the place of gearing in running heavy machinery. The business was of slow growth at first, however, and it was several years before the "ready made" belting came into general use.

Among the earliest to perceive the large field offered by this new specialty was Pliny Jewell, of Hartford, Conn., the founder of the house of P. Jewell & Sons, whose extensive factory for the manufacture of belting furnishes the subject for the illustrations on the first page of to-day's paper. Mr. Jewell had been a tanner, but, in 1849, determined to commence the manufacture of leather belting, and in connection with his son Marshall, founded the house of P. Jewell & Son. Three other sons were afterward admitted—Pliny, Charles A., and Lyman B.—constituting the firm of P. Jewell & Sons, which style has since been maintained, although the father has been dead several years. Besides being energetic and thoroughly wide-awake business men, they were a family of tanners, and therefore had the best of preparation for making a success in what was then a comparatively new business. The use of leather belts rapidly increased, and the business was soon greatly enlarged, and it was only a short time before the goods manufactured by this house were to be found in the factories of every State in the Union. The firm have not been content to stop here, however, but for some years past they have exported and sold large quantities of belting to European mill owners, and the demand for belts of their manufacture, from the foreign as well as the home trade, is constantly increasing.

The belt factory of P. Jewell & Sons, at Hartford, is a five story building, 185 feet long by 44 feet wide, with an L three stories high. The leather from which the belts are made comes to the factory direct from a large tannery in Michigan owned and operated by the firm. The leather all comes "in the rough," as it is called, that is, it is only tanned and dried, but is in no way finished at the tannery. The first operation to which it is subjected after coming to the factory is the scouring, as shown in the upper right hand sketch. Thorough scouring is one of the indispensable requisites in good belt making, for by this operation the "bloom" from the bark liquors, with other coloring and resinous matters, not actually adding to the strength of the leather, are washed out. For this purpose the leather, having been thoroughly wet, is placed—either a whole or half hide, as may be desired, at a time—upon the movable bed of the scouring machine, which may be easily and quickly moved from side to side, or forward and backward, as necessary. Over this bed, and attached to an arm from a shaft, is a sort of box, in which are fixed scouring stones similar to those used by curriers. There are two of these stones, one in each side of the box, and as the arm moves forward one of them makes a stroke on the leather, while with the backward movement the other gives a similar stroke. These stones are accompanied by stiff brushes, a small jet of water being at the same time constantly directed to where the stoning and brushing are being done. The workman is all the time moving the table on which the leather is spread out, so that this scouring may be effected on every portion, and he can make the strokes of any desired force. This machine will do as much scouring as it would be possible for three or four men to do by hand, and it is thought to do the work far better for leather to be used in making belts, as the powerful strokes it gives are very effectual for the thorough "setting out," or smoothing of the leather, making it to lie flat and even.

The illustration to the left of the scouring room shows the workmen engaged in cutting up the leather, all wide belts being cut from the middle of a whole hide, and each width of belt having an especial part of the hide from which it is most desirable to cut it.

The "stretching," as shown in another sketch, is of especial importance in the making of a belt which is expected to run without giving trouble, for the necessity of having frequently to "take up" belts which stretch so as to become too loose is a serious inconvenience in a factory, where, oftentimes, a number of hands must stand idle until the difficulty is remedied. The stretching is accomplished by making fast each end of a piece of leather in clamps, then, with a lever, putting on all the strain which the leather will bear, and allowing it to stand under this strain for several hours. In this way the stretch is generally so well taken out that a new belt, where it has been properly put up, may often be run for months without requiring any attention.

The "jointing" and "cementing," as shown in another sketch, embrace departments of the business which formerly received very little attention, but are now recognized as of great importance. In the jointing, the ends having been made perfectly square, they are beveled and skived down, so that, where the laps occur, the belt shall be of an even and uniform thickness, and the fitting as nice and true as if the whole belt were cut out of one piece of leather. It is especially important that this work be well done, for the smoother the surface of the belt is made the less air will pass under it and between it and the pulley, and the closer the contact of the belt and pulley the more machinery will the belt drive. The cementing of these ends or laps together is said to contribute much more to the strength of the belt than the riveting, and we have seen tests of belting, in which only cement was used for fastening the different lengths, where the leather gave way at other places rather than where the joint was made.

The room devoted to riveting and finishing is shown in the large engraving at the bottom of the page, which gives a good idea of the extent of the business, and the methodical manner in which it is conducted.

It is impossible, however, to make good belts without having a first-rate selection of just the right kind of leather—to obtain which the hides should be selected and the tanning operation conducted with that end in view. The Messrs. Jewell have a large tannery in Michigan, with a capacity for tanning 50,000 hides a year, which they run for the especial purpose of giving them just the kind of leather they use in their belt factory. It is located where there is an abundance of bark, and where the choicest hides for belting are to be had, namely, those from the grass-fed prairie cattle. These hides are, as a rule, superior to those taken from the stall-fed cattle of the Eastern States, the fiber of the hide being more compact and solid, and making leather less liable to stretch than any other. The tanning process is not hurried, as it is in many cases with sole leather, and no hides are "worked in" which have any brands or cuts that would injure a belt. The best hides for this purpose are those from cattle four or five years old, as the hides of animals of that age have not been repeatedly stretched and shrunken, from changes in their condition, as is often the case with older ones, and the leather made from such hides is more likely to permanently remain straight. "I give it as my judgment, after thirty years of observation and experience," says the Hon. Marshall Jewell, from whom most of the above facts have been obtained, "that the best and cheapest belt in the world is one made from the hide of a four or five year old bullock that has been fed on grass, the hide being tanned thoroughly with bark, and a long time given to the process, and the belt then being run with the grain or hair side to the pulley."

It would be strange, however, in a business of such magnitude as the belt manufacture has now become, and which has attained its present proportions so recently, if there were not many competitors in the field now principally occupied by leather belting. India rubber and gutta percha, and canvas, or one of the former in combination with the latter, are extensively used in out-of-door work and in wheel pits, or where the belts are constantly exposed to water, and for such work they serve a good purpose. In Europe there is a great variety of cheap belts, one kind consisting of refuse pieces of leather wired together. Belting is also made there of a species of Helvetia leather, so little tanned that it is here called rawhide; it is light, strong, and tough, but stretches easily, and is not as serviceable as are belts made of bark-tanned leather. The rawhide belting occasionally used here has something of the same characteristics. Many attempts have also been made to utilize metal in the manufacture of belts, but none of them have thus far met with any considerable success. A belt of this kind was brought forward in Russia some years ago, consisting of a chain whose links were locked together by small rods. Mr. Jewell, while Minister to Russia from the United States, negotiated for the control of the patent for this country, and put some of this belting in use on his own machinery. It was found, however, that this chain belt never got through stretching; the links became flattened and wore into each other, so that the belt lengthened a little every day, and, during the year in which it was in operation here, it had to be "taken up" as often as once a week, to the great annoyance and inconvenience of all who were dependent on it in their work. On a visit last year to the factory where it was manufactured, in St. Petersburg, Mr. Jewell found that its use had been abandoned for the above reasons. Notwithstanding, therefore, all the efforts which have been and are being made to introduce other kinds of belting, experience has thus far proved that bark-tanned leather makes the best, and, for most purposes, the cheapest article furnished, when its perfect reliability and the amount of wear it will give are taken into consideration.

The Hon. Marshall Jewell.

Perhaps it is proper, in concluding this sketch of the leather belting manufacture, as conducted by one of the representative firms in that line of business, to give some of the principal facts in the life of the gentleman who is now at the head of the firm, who was in the house at its commencement, and who has, besides taking an active part in this way in the industrial progress of the country, filled several prominent positions in public life. Marshall Jewell was born in Winchester, N. H., October 25, 1825. For five generations back the Jewells had been tanners, and young Marshall, after receiving a common school education, supplemented by a few terms at the village academy, commenced learning his trade in his farther's tanyard. He afterward learned the business of currying, or the finishing of upper leather, and then, with the disposition for change so common with boys, drifted westward, and became engaged in the telegraph business, when that specialty was still in its infancy. He was for a while in the offices at Rochester, N. Y., Akron, O., Columbia, Tenn., and Jackson, Miss., and, in 1849, received an offer of the superintendency of the New York and Boston Telegraph Line, which he came North to accept. On reaching Hartford, however, he found his father started in the manufacture of belting, and, abandoning the telegraph business, cast in his fortunes with him. Mr. Jewell visited Europe in 1859 and in 1860, and again in 1865, when he spent a year abroad, visiting Asia and Africa; he also attended the French Exhibition of 1867, and in each of these visits he did good work, either in the way of extending the trade of his firm, or in gleaning information that would be of value in the prosecution of his tanning and belting business.

In 1868 Mr. Jewell's name was first brought forward in a political canvass; he was nominated for governor of Connecticut. Four times afterward he ran for the same office, during periods of great excitement and when the personal character of the nominees was subjected to the closest scrutiny, and was thrice elected, thus being successful in the race three times out of five in five successive years. In 1873, just after he had retired from the governorship, he was appointed United States Minister to St. Petersburg. While there he found that many fraudulent imitations of American manufactures were being sold, notably in sewing machines, Fairbanks' scales, Collins' axes, etc., all of which were being palmed off as of American make. He at once commenced negotiating a trade mark treaty with Russia, which was speedily concluded and ratified, by which American interests in goods covered by trade marks were protected. He also, at the especial suggestion of Mr. Jackson S. Schultz, made a careful investigation by which he discovered the process of making the peculiarly scented Russia leather, which had theretofore been made only in Russia, the means by which this particular odor was imparted to the leather having been kept secret. He found that the manufacture and coloring were carried on according to substantially the same principles as those followed here, but that the aroma was given to the leather by the use of a small amount of birch bark tar, some of which he purchased and sent to New York. Since that time American manufacturers have made "Russia" leather as good as any that was ever made in Russia; they have also made a good deal which was greatly inferior, but the poor as well as the good have had what is called the "genuine Russia smell," so that this no longer affords a criterion by which to judge of the quality of the leather or the place of its manufacture.

On the 1st of July, 1874, President Grant invited Mr. Jewell to return and take a place in his Cabinet as Postmaster General, which position he assumed on the 1st of September following. During his administration of the office, "straw" bidding, which had become a great evil in the department, was suppressed, and the general efficiency of the postal service was greatly increased. He also negotiated a postal treaty with Canada, whereby the postage between the two countries was made the same as between different offices at home. Mr. Jewell retired from the Cabinet July 14, 1876, since which time he has given his attention entirely to the business of his firm.

Notes on Belting.

We think it would be greatly to the advantage of mill-owners, dyers, finishers, etc., if everybody who supplied them with machinery and other goods would imitate more largely the example taken by Messrs. S. E. Morris & Co.,

as regards their belting, in giving precise instructions respecting the employment of such machinery or goods. Without holding ourselves responsible for the following notes on belting, we are glad to find space for them, as embodying the result of the experience of a firm who have had much to do in the matter. They say: The formula given below is based on the experience of engineers in Great Britain, America, and France. It serves the purpose of showing what width of belt will do the required work most efficiently, and at the same time last the maximum number of years. Many engineers, more especially in this country, are content to provide belts of greatly reduced width, and of single substance instead of double; hence the frequent complaints of their stretching, breaking, and lasting so short a time. As a matter of convenience and arrangement of machinery, a narrower belt than that which is shown by the generally accepted formula is often imperative; but, in the absence of any such conditions, it is questionable economy to depart materially from it. The following may be regarded as an axiom: To use a belt of ample width and substance for the work required is to secure for it a long existence, with satisfaction to all concerned.

Directions for Calculating the Width of Belts Required for Transmitting Different Numbers of Horse Power.

Multiply 33,000 by the number of horse power to be transmitted; divide the amount by the number of feet the belt is to run per minute; divide the quotient by the number of feet or parts of a foot in length of belt contact with smaller drum or pulley; divide this last quotient by six, and the result is the required width of a single tanned leather belt in inches.

Explanations.—The figures 33,000 represent the number of lb. a horse is reckoned to be able to raise one foot high in a minute. To obtain the number of feet a belt runs per minute, find the number of revolutions per minute of the driving shaft and multiply by the circumference of the drum, which is always 3·1416 its diameter. The final division by six is because half a pound raised one foot high per minute is allowed to each square inch of belting in contact with the pulley; a pound must therefore be allowed to two square inches, or six pounds to a strip one foot long and one inch broad.

Example.—Required the width of a single belt, the velocity of which is to be 1,500 feet per minute; it has to transmit 10 horse-power, the diameter of smaller drum being four feet, with five feet of its circumference in contact with belt:

$33{,}000 \times 10 = 330{,}000 \div 1{,}500 = 220 \div 5 = 44 \div 6 = 7\frac{1}{3}$ inches, the required width of belt.

Directions for Calculating the Number of Horse-power which a Belt will transmit.

Divide the number of square inches of belt in contact with the pulley by two; multiply this quotient by the velocity of the belt in feet per minute; again divide the total by 33,000, and the quotient is the number of horse-power.

Explanations.—The early division by two is to obtain the number of lb. raised one foot high per minute, half a pound being allowed to each square inch of belting in contact with the pulley.

Example.—A six inch single belt is being moved with a velocity of 1,200 feet per minute, with four feet of its length in contact with a three foot drum. Required the horse-power:

$6 \times 48 = 288 \div 2 = 144 \times 1{,}200 = 172{,}800 \div 33{,}000 =$ say $5\frac{1}{4}$ horse-power.

It is safe to reckon that a double belt will do half as much work again as a single one. Belting made from "Helvetia" leather is much stronger and will bear a heavier strain than that made from ordinary tanned leather.

Hints to Users of Belting.

1. Horizontal, inclined, and long belts give a much better effect than vertical and short belts.

2. Short belts require to be tighter than long ones. A long belt working horizontally increases the grip by its own weight.

3. If there is *too* great a distance between the pulleys, the weight of the belt will produce a heavy sag, drawing so hard on the shaft as to cause great friction at the bearings; while at the same time the belt will have an unsteady, flapping motion, injurious to itself and to the machinery.

4. Care should be taken to let belts run free and easy, so as to prevent the tearing out of lace holes at the lap; it also prevents the rapid wear of the metal bearings.

5. It is asserted that the grain side of a belt put next to the pulley will drive 30 per cent. more than the flesh side. Experience can alone verify this; but when belts are required to be worked this way, the fact should be stated in the order, so that the riveting may be arranged accordingly.

6. To obtain a greater amount of power from belts, the pulleys may be covered with leather; this will allow the belts to be run very slack, and give 25 per cent. more durability.

7. Leather belts should be well protected against water and even loose steam or other moisture.

8. Belts working in very wet places should be ordered to be waterproofed.

9. A careful workman will see that his belts are redressed about every four months, by sponging the dirt from them with warm soap and water; then drying with a cloth, and, while still damp, rubbing in castor oil or currier's grease, which will be readily absorbed, the leather being moist from washing. Castor oil has the additional advantage of preventing rats attacking the leather.

10. In putting on a belt, be sure that the joints run with the pulleys, and not against them.

11. In punching a belt for lacing, it is desirable to use an oval punch; the larger diameter of the punch being parallel with the belt, so as to cut out as little of the effective section of the leather as possible.

12. Begin to lace in the center of the belt, and take care to keep the ends exactly in line and to lace both sides with equal tightness. The lacing should not be crossed on the side of the belt that runs next the pulley. Thin but strong laces only should be used.

13. It is desirable to locate the shafting and machinery so that belts shall run off from each other in opposite directions, as this arrangement will relieve the bearings from the friction that would result where the belts all pull one way on the shaft.

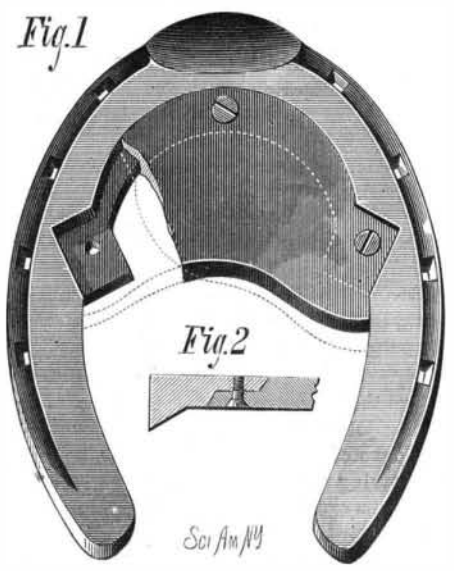
14. If possible, the machinery should be so planned that the direction of the belt motion shall be from the top of the driving to the top of the driven pulley.

15. Never overload a belt.

16. A careful attendant will make a belt last many years, which through neglect might not last one.—*Textile Manufacturer.*

NEW WEIGHTED HORSESHOE.

The annexed engraving represents an improved weighted

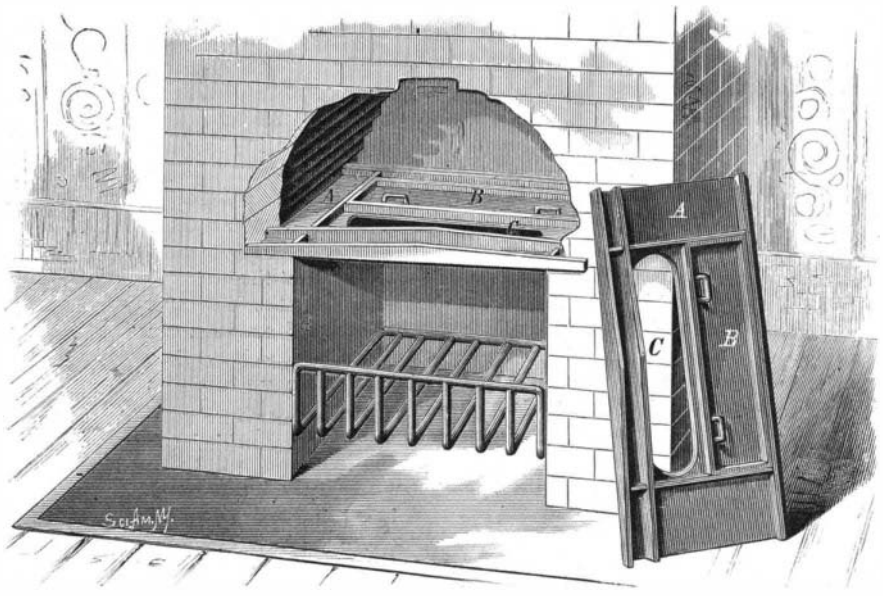


SEIXAS' WEIGHTED HORSESHOE.

horseshoe invented by Mr. Eugene E. Seixas, of Galveston, Texas. The improved horseshoe is designed to be used in training horses to trot rapidly by causing him to extend his strides. It squares his step, and may be used for preventing him from striking his knees with his feet.

In the engraving a part of the weight is broken away to show the form of the shoe under the joint, and Fig. 2 is a section of a portion of the shoe and weight taken through the joint. The weight is fitted to a rabbet or recess formed in the shoe, and is held in place by three screws, so that it may at any time be removed if required.

When it is necessary to use the device for preventing the horse from striking his knees with his feet the weight is made to extend farther back upon one side than the other, as shown in the dotted lines in Fig. 1.



FIREPLACE DAMPER PLATE AND ARCH BAR.

IMPROVEMENT IN FIREPLACES.

The annexed engraving represents an improved fireplace damper plate and arch bar recently patented by Mr. Clark Hanes, of Wheeling, West Va. It serves the purpose of an arch bar for sustaining the brick wall over the fireplace, opening also as a damper for regulating the draught and for preventing the falling of soot when the fireplace is not in use.

The engraving shows the plate and damper in position in the fireplace, and also gives a face view in perspective.

A is a cast iron plate of sufficient length to rest on the walls at the side of the fireplace, and having the oblong aperture, C, which is sufficient for the escape of smoke. A damper, B, fitted between two ribs on the plate, A, is capable of being moved so as to cover the opening, C. The plate is ribbed to give it sufficient strength to sustain the weight of the wall above the fireplace, and thus obviates the necessity of building an arch for that purpose.

This invention facilitates the construction of fireplaces, and renders them free from one of the principal objections brought against them, that is, the escape of soot through the flue opening into the room when the fireplace is not in use.

RECENT INVENTIONS.

Mr. Solomon B. Ellithorp, of Rochester, N. Y., has invented an improvement in waxing mechanisms for sewing machines. It consists of two arms carrying sponges, which are moved reciprocally by the operating mechanism of the machine in such a manner that they pass over melted wax held in a suitable receptacle, taking up a suitable quantity thereof, and at the proper time are rubbed and clasped against the two threads carried by the needle and shuttle.

An improved cord adjuster has been patented by Mr. William W. Batchelder, of New York city. The object of this invention is to furnish cord adjusters and holders so constructed that cords may be moved longitudinally through them as required, and may be held securely in place when adjusted. It consists in a cord adjuster and holder formed of a tube having longitudinal flanges or ribs upon its inner surface, an interior swiveled spiral and a swiveled collar, so constructed and arranged that the cord may be moved longitudinally by turning the collar.

Mr. Alfred E. Feroe, of Tivoli, N. Y., has patented an improved process of obtaining wort, which consists in first dissolving the diastase of the ground malt in warm water at less than a converting temperature, and then bringing the mash to and keeping it at a converting heat by continuously drawing the wort from the bottom of the tub, heating, and passing it through the mash, as specified.

Mr. Edward Earle, of Brooklyn, N. Y., has patented an improved fishing rod which consists in providing the ordinary ferrules or tubes that are fitted to slip together with an annular cap or socket piece that covers the end of the outer tube and prevents water from working in and rotting the rod.

Mr. Charles J. Everickx, of Paris, France, has patented a system of articulation or joints for portable furniture, so that it can readily be folded up to occupy a very small space and can be conveniently carried.

New York City Fire Department.

The statistics of the Fire Department show that there were 1,541 fires in the city in 1879, against 1,655 in 1878. In 1877 there were 1,450. The only printed statistics with which these can be compared are those of the first three years of the existence of the paid department—1866, 1867, and 1868—when there were 798, 873, and 740 fires respectively. The increase in number of fires is accounted for by the increase of the city and the addition of such districts as Westchester to the area covered by the statistics. The higher efficiency of the Fire Department is indicated in the fact that while the percentages of total destruction of buildings by fire were 7, $6\frac{1}{5}$, and 5 per cent for 1866, 1867, and 1868 respectively, the percentages for 1877, 1878, and 1879 were only 3·45, 1·14, and 1·6 per cent of total loss. This difference is said to be due to the perfected system of fire alarms now in use; the convenient arrangement of quarters for men and horses, insuring the promptest response to the signals, and the introduction into the city of a large number of new hydrants, which have always been erected as soon as the Commissioners requested them.

The principal causes of fires have been carelessness on the part of servants or occupants of houses (this is accountable for nearly one-quarter of all the fires), foul chimneys, explosion of kerosene lamps, and window curtains near gas jets. The number of fires from kerosene has been reduced from 136 in 1877 to 92 in 1879, by the methodical inspection of the oil offered for sale, and the regulation of its quality and of the quantity kept in store. Men are constantly employed in collecting samples, which are labeled and tested, and the dealer is attended to if his sample is below the standard fixed by law. The dealers are getting to understand that they cannot keep an inferior oil without detection, and the consequence is that there is seldom any offered for sale that is not of good quality.