back of the knife. Four days after the incisions have been made, the lac begins to flow from the tree and is collected with a strip of wood and put into a bamboo tube (Fig 1, No. 3). After the lac has been removed from five or six trees, the collector returns to the first tree and makes an incision therein over the others, and so on with the remaining trees. It is necessary to remove the lac as soon as possible after it begins to flow, otherwise it would become brown, and even black in the air.

A workman can tap two hundred trees in a day. A tree of a circumference of from 15 to 20 cm. will yield from 90 to 95 grammes of varnish per season. Varnish of the first quality is collected from May to October. During the month of October the lac is of second quality. The varnish that comes from the branches is collected with a special knife (Fig. 1, No. 5). From the bamboo tubes the varnish is poured into a pail capable of holding 9 kilogrammes. The lac is stored in a similar vessel, but of a capacity of 30 kilogrammes.

When the tree ceases to yield varnish, the branches are lopped off and cut into pieces one meter in length, which are tied up in packages. After these have been dried for three or four days in the sun, they are immersed for five or six days in cold water, and are then incised with a knife in the form of a corkscrew. The juice that exudes is collected in a pail. This is lac of the third quality. The lac is preserved in a vessel which is hermetically closed. A hundred varieties of lac are known in China and Japan. Lac is mixed with iron or steel filings to form a paint that is used for covering wood and imitating slate. One variety of lac is prepared thus: Three hundred and seventy-five grammes of lac and 75 of oil are mixed and passed through cloth and 50 grammes of iron filings are added. Red lac is obtained by mixing lac with oil, vermilion and extract of Gardenia florida.

Colored lacs are obtained by mixing colored powders with ordinary lac. Black lac is obtained by exposing ordinary lac to the sun in a wooden bowl (Fig. 5, No. 1), which is placed in an oblique position (Fig. 5, No. 3). During this time a workman stirs the lac with a spatula in taking care to add a little iron filings to it. The Chinese lac is the product of the same tree (Fig. 5, No. 4). Lac is employed in the toy trade, marquetry, cabinet making, etc.—La Nature.

Engineering Tools at Pompeii.

Under the title of "Things of Engineering Interest Found at Pompeii," Professor Goodman lately gave his inaugural lecture in the engineering department of the Yorkshire College, Leeds. The lecturer remarked that he had recently visited Pompeii, and was not only charmed by the great beauty of the works of the ancient Romans, but also by their extreme ingenuity as mechanics—in fact, it was a marvel how some of the instruments and tools they were in the habit of using could possibly have been made without such machinery as we now possess.

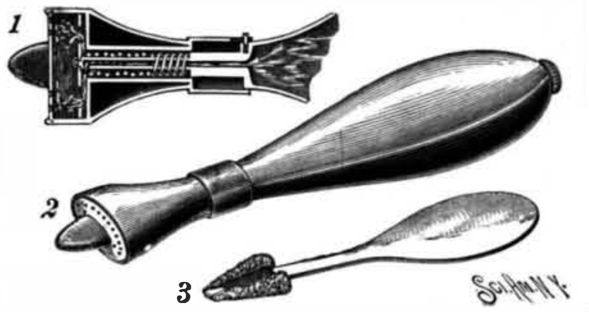
After explaining the situation and destruction of Pompeii by showers of ashes and mud, not lava, as is usually supposed, in the year 79 A.D., Professor Goodman showed a series of about fifty lantern slides, prepared from photographs taken by himself in Pompeii last Easter. The streets, he explained, were used as waterways to carry off the surface water, and probably sewage, from the houses. The pavements were raised about a foot above the streets, and stepping stones were provided at intervals for foot passengers.

The horses and chariot wheels had to pass between, and in many places deep ruts have been worn by the chariot wheels in the stone paved streets. The water supply of Pompeii was distributed by means of lead pipes laid under the streets. There were many public drinking fountains, and most of the large houses were provided with fountains, many of most beautiful design. The amphitheater, although a fine structure, capable of seating 15,500 people, was small compared with many in Italy. The bronzes found at Pompeii reveal great skill and artistic talent. The bronze brazier and kitchener were provided with] boilers at the side and taps for running off the hot water. Ewers and urns have been discovered with internal tubes and furnaces precisely similar to the arrangement now used in modern steam boilers. Several very strong metal safes, provided with substantial locks, have been found. The locks and keys were most ingenious, and some very complex. On looking at the iron tools found in Pompeii, one could almost imagine he was gazing into a modern tool shop, except for the fact that the ancient representatives have suffered severely from rust.

Sickles, billhooks, rakes, forks, axes, spades, blacksmith's tongs, hammers, soldering irons, planes, shovels, etc., are remarkably like those used to-day; but certainly the most marvelous instruments found are the surgical instruments, beautifully executed, and of design exactly similar to some recently patented and reinvented. Incredible as it may appear, yet it is a fact, that the Pompeiians had wire ropes of perfect construction.

A BUTTONHOLE MOISTENER.

The illustration represents a simple device adapted to moisten the starched and stiff surface around a buttonhole, especially in collars and cuffs, to facilitate buttoning. It has been patented by Charles Miller, of No. 239 Fourth Avenue, New York City. As shown in perspective and section, Figs. 1 and 2, the body of the device has a projecting wedge-like lip adapted to enter a buttonhole, and there are apertures in the front part of an adjacent portion adapted to hold a sponge or other absorbent material, at the back of which is a spring-pressed perforated plate. An aperture in the handle, closed by a screw plug, provides for supplying water to moisten the sponge. Fig. 3 represents a modification of the device in which a sponge is attached in

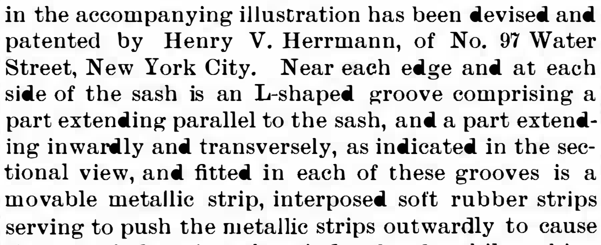


MILLER'S BUTTONHOLE MOISTENER.

pointed wedge shape to a suitable handle, the sponge to be then dipped in water as used.

AN IMPROVED CAR WINDOW SASH.

To enable a car window to be readily moved in its beads or frame, while the sash also fits so closely as to exclude wind or rain, the improvement represented in the accompanying illustration has been devised and patented by Henry V. Herrmann, of No. 97 Water Street, New York City. Near each edge and at each side of the sash is an L-shaped groove comprising a part extending parallel to the sash, and a part extending inwardly and transversely, as indicated in the sectional view, and fitted in each of these grooves is a movable metallic strip, interposed soft rubber strips serving to push the metallic strips outwardly to cause them to bind against the window beads, while making an easy and frictionless connection between the parts. The ends of the strips have flanges seated in recesses in the upper and lower edges of the sash. Secured to each vertical edge of the sash is also a metallic strip whose vertical edges project sufficiently to engage the edges of the rubber strips at the sides when the latter are spread by compression, thus preventing contact of the rubber with the wood of the window frame. This construction is designed to compensate for all shrinking and swelling of the wood of car windows,



HERRMANN'S SASH FOR CAR WINDOWS.

enabling them to be readily moved up and down at all times, while at the same time a tight and weather-proof joint is secured.

A New Waterwheel.

A waterwheel of remarkable construction has been introduced in the North Star mine, Grass Valley, Cal. It is eighteen feet in diameter, weighs 10,500 pounds and develops 250 horse power, running under 750 feet head, at 110 revolutions, and is directly connected to the shaft of a duplex compressor, compound tandem type, of same capacity. The design of this wheel is novel. From a cast-iron hub radiate twenty-four steel spokes, which are connected to a rim made up of angle iron properly shaped, having a slat for the buckets, which are bolted to the periphery, the strain being taken by four heavy steel truss rods. The large diameter of the wheel is for the purpose of giving proper speed to the compressor under the high head available; and the water is applied to the wheel through a variable nozzle controlled by an automatic regulator, the latter maintaining a uniform speed on the wheel, with a variation from full load down to twenty-five per cent of the same—a great economy of water.

Doctor of Machinery.

Among the multitudinous trades and professions in New York there are many which are entirely unknown, even by name, to the general public. One of the least known and most interesting is that of the expert in machinery. The work of a machinery specialist is far higher than that of a skilled engineer, and many years of experience and special training are necessary to fit the expert for his duties. There are only about half a dozen of these men in the country, one in every large city. When anything goes wrong with a machinery plant of whatever nature, the cause of which the engineer in charge, frequently the builder of the engines, cannot discover, the machinery doctor is called in. Every chief engineer of a big plant may be called a specialist so far as the machinery under his charge is concerned, but the specialist in machinery is an expert in engines of every description.

Though he has never seen the engine before, he rapidly diagnoses the case and prescribes a remedy, just as a doctor does for a sick patient. The instrument most used by him is a dentophone, which consists of a thin steel rod about a foot long, which he holds between his teeth and applies to the head of the cylinder. To the practiced ear of the expert every sound transmitted from the cylinder tells a story. The working of the piston in the cylinder, and, indeed, of the whole engine, can be heard distinctly in this manner by anybody, but it takes an expert to tell just what those sounds mean.

In the case of a mysterious knocking which was heard in the cylinder of the big driving engine in a large spinning factory not long ago, an expert was called in to determine the cause. Every method had been tried to discover where the trouble was, but without avail. Bearings were examined, the cylinder was taken apart, and every part well oiled, all to no purpose. When the expert came he traced the mysterious knocking from the cylinder, along the piston rod, crank shaft, and through the main shaft, away off among the looms, where one of the looms was found to be the cause of the trouble.

Often an expert's services are required in the case of synchronizing looms. If all the looms in a big spinning factory happen to beat together, as sometimes happens, the vibration is strong enough to bring the building down. For the same reason soldiers always break step when going over a suspension bridge, for otherwise the measured tramp of the many feet all striking the ground at the same time would seriously endanger the structure. The power of sound is also enormous when exerted in a particular way. Every substance in nature has a keynote, and when a sound of the same pitch is caused near it, a considerable amount of vibration is produced. When the great tubular bridge was being built across the Menai Straits, which divide England from the island of Anglesea, a traveling violinist nearly caused the collapse of the whole structure. He happened, while playing, to hold for a considerable time a note which chanced to be the keynote of the huge bridge structure. The sound echoed along the vast tube and re-echoed with ever-increasing force until the whole bridge vibrated as if an earthquake were taking place. The bridge engineer, who was near by, instantly divined the cause, and stopped the playing of the violinist.

Part of the business of the machinery doctor consists in so arranging the distribution of looms and other machinery that their working will not endanger the stability of the factory. Defects in a boiler can also be instantly determined by the practiced ear of the specialist. A plate in the boiler is selected which is known to be in good condition, and he takes mental note of the pitch of the sound made when the plate is struck with a hammer. All the other plates are struck in the same way, and any one which does not ring true and conform to the correct pitch is examined and replaced. A case is on record where a machinery specialist was crossing the ocean and detected crystallization in the center of the shaft, thereby averting what might have been a serious accident in midocean. Measures were taken to strengthen the shaft in the place where the quick ear of the expert detected weakness, and when the vessel was docked his suspicions proved correct.

Few men even with the most exhaustive training can become experts at this business, as it requires a marvelous quickness of ear and delicate perception of sound with which few men are blessed. Technical knowledge is of little avail of itself, and a fine engineer might be a poor machinery doctor, just as a great musician might make an indifferent piano tuner. Whenever a big mill is erected, a specialist is always consulted as to the placing of the machinery, and his fee is generally well worth the expense and trouble which an injudicious distribution of machines may cause.—N. Y. Tribune.

Testing House Pipes and Drains.

A good article on this subject, calculated to enlighten owners and occupants as well as plumbers, may be found in Domestic Engineering for September. These tests are named the water test, the smoke test, and the peppermint test. Presuming that the pipes are all in place and connected, but yet uncovered, and all openings closed by plugs (there are a variety of plugs for this purpose, generally constructed to become tight by expansion under pressure of a screw), the entire system is then filled with water. If the water at the highest point does not settle away after standing some time, the system is watertight. Connections should then be completed. If the water settles, there are leaks, which should be carefully sought out and stopped. After the connections of the fixtures are made, the system should be tested again. This may be done by the smoke test, or the peppermint test, or both in succession. The peppermint test is considered by most plumbers the more delicate, but it is more difficult to apply. The smoke test is performed by generating smoke and forcing it into the pipes, while all windows, doors, or other openings which permit free circulation of air into and through the building are closed. If smoke is detected anywhere in the building there are leaks, which may be discovered by the visible escape of smoke therefrom.

The peppermint test is applied by taking a small bottle of oil of peppermint and a can of boiling water on the roof and pouring it down the soil pipe, immediately closing the top and having someone in the house detect if any smell of peppermint becomes apparent, and where it comes from. This test requires delicate handling, and is troublesome. The person on the roof will have to remain some time, for if he comes into the house, he brings the odor of peppermint with him and spoils the test.

Maguire tabulates the following list of fifty-one specific insanitary and dangerous defects actually discovered in inspection of dwelling houses. These may prove suggestive to plumbers who are making inspections of systems of plumbing which are suspected of being defective:

1. Common brick or stone built drains under basement.
2. Large built drains, under or near dwellings.
3. Pipe drains of larger diameter than actually necessary.
4. Pipe drains broken, or with leaking points, saturating the subsoil with sewage.
5. Pipe drains with built or imperfect junctions.
6. Pipe drains under dwelling without sufficient fall.
7. Pipe drains with fall in the wrong direction.
8. Drains of any kind without proper intercepting traps.
9. Drains of any kind without constant free current of air throughout.
10. Drains without easy means of inspection.
11. Drains carried from public sewer direct under hall door steps and under scullery floor, instead of across open area.
12. Rat burrows from built drains, undermining floors.
13. Rat burrows from public sewers worked along outside pipe drains into houses.
14. Defective connection between soil pipes and drains.
15. Soil pipes inside houses under almost any circumstances.
16. Soil pipes inside or outside without ample ventilation.
17. Soil pipes through pantries, larders, or stores.
18. Defective, badly placed, or ill constructed water closet apparatus and housemaids' slopsinks.
19. Water closet cisterns with overflows joined to soil pipes or drains.
20. Safe trays under water closets joined to soil pipes or drains.
21. Two or more water closets or sinks on one soil pipe, untrapping each other when used.
22. Overflow pipes connected to soil pipes liable to become untrapped, all very dangerous.
23. Water supplies over troughs taken from water closets or other contaminated cisterns, and liable to be used by careless servants to fill bedroom carafes for drinking.
24. Taps for supplying bedroom water fixed over housemaids' slopsinks, liable to be polluted by splash from slops emptying.
25. House cisterns, with overflows, joined to soil pipes or drains.
26. Traps of every kind, without ample ventilation to guard them.
27. Scullery sinks connected direct to drains admitting foul air, not only through traps, but through joints of brickwork and plaster all round.
28. Bell taps, with loose covers on scullery sinks.
29. Gullies or traps in floors of sculleries, laundries, larders, or basement, etc., connected to drain, and usually dry and untrapped, or full of foul deposit.
30. Ventilating foul air shafts, discharging near chimneys or windows or ventilating openings.
31. Rain pipes used as ventilators for drain discharging foul air near bedroom windows or under roof eaves.
32. Rain pipes used as, or connected to soil pipes, likely to freeze soil pipe solid in severe winter.
33. Rain pipes passing down center of houses connected in any way to drains.
34. Open rain courses from valley gutters, passing under floors to outside down pipes connected to drain.
35. Rain pipes of low roofs, bow windows, or porches connected direct into drain.
36. Ashpits located near larder, pantry, or dwelling.
37. Ashpits liable to let moisture soak into house.
38. Ashpits capable of retaining moisture or unventilated.
39. Rat burrows from defective drains in neighboring premises.
40. Defective drainage or fittings in neighboring premises.
41. Any direct communication with drains of neighboring premises.
42. Water tanks in areas, near ashpits or sculleries, or with any connection of overflow to drain.
43. Bath waste or overflow pipes connected to soil pipes or drains.
44. Wash hand basin wastes or overflows connected to soil pipes or drains.
45. Water closet cisterns under bedroom or parlor floors.
46. Cesspools near houses, or unventilated anywhere.
47. Cesspools or drains near wells.
48. Drains crossing your house from neighbor's premises.
49. Field or surface water drains, with open joints under basement connected to house drains direct.
50. Damp basements or damp walls.
51. Drinking water defects of source supply or storage.

What Shall We Eat?

The Canadian Baker and Confectioner, condensing a pamphlet issued under the auspices of the United States Department of Agriculture, prepared by W. O. Atwater, Ph.D., professor of chemistry in Wesleyan University, on the nutritive value of food products, says:

"A quart of milk, three-quarters of a pound of moderately fat beef—sirloin steak, for instance—and five ounces of wheat flour all contain about the same amount of nutritive material; but we pay different prices for them, and they have different values for nutriment. The milk comes nearest to being a perfect food. It contains all the different kinds of nutritive materials that the body needs. Bread made from the wheat flour will support life. It contains all of the necessary ingredients for nourishment, but not in the proportions best adapted for ordinary use. A man might live on beef alone, but it would be a very one-sided and imperfect diet. But meat and bread together make the essentials of a healthful diet. Such are the facts of experience. The advancing science of later years explains them. This explanation takes into account, not simple quantities of meat and bread and milk and other materials which we eat, but also the nutritive ingredients or 'nutrients' which they contain."

The chief uses of food are two: To form the material of the body and repair its wastes; to yield heat to keep the body warm and to provide muscular and other power for the work it has to do. Dr. Atwater has prepared two tables showing, first, the composition of food materials, the most important of which are the nutritive ingredients and their fuel value; second, the pecuniary economy of food, in which the amount of nutrients is stated in pounds. In the first table we find that butter has the greatest fuel value, fat pork coming second, and the balance of the foods mentioned being valued as fuel in the following order: Cheese, oatmeal, sugar, rice, beans, cornmeal, wheat flour, wheat bread, leg of mutton and beef sirloin, round of beef, mackerel, salmon. Codfish, oysters, cow's milk, and potatoes stand very low as fuel foods.

From the second table we learn that the greatest nutritive value in any kind of food of a specified value (Dr. Atwater takes 25 cents' worth of every kind of food considered) is found in cornmeal. In 10 pounds of cornmeal there are a trifle more than 8 pounds of actual nutriment. In 8⅓ pounds of wheat flour there are over 6¼ pounds of nutriment; in 5 pounds of white sugar there are 4½ pounds of nutriment; in 5 pounds of beans there are 4 pounds of nutriment; in 20 pounds of potatoes there are 3¾ pounds of nutriment; in 25 cents' worth of fat salt pork there are 3½ pounds of nutriment; in the same value of wheat bread there are 2¼ pounds; in the neck of beef, 1¾ pounds; in skim milk cheese, 1¾ pounds; in whole milk cheese, a trifle more than 1½ pounds; in butter, 1½ pounds; and in smoked ham and leg of mutton about the same; in milk, a trifle over 1 pound; in mackerel, about 1 pound; in round of beef, ¾ of a pound; in salt codfish and beef sirloin, about ½ a pound; in eggs at 25 cents a dozen, about 7 ounces; in fresh codfish, about 6 ounces; and in oysters at 35 cents a quart, about 3 ounces.

Death of a Famous Inventor.

Something like forty years ago one of the earliest clients we remember, as an applicant for a patent, through this office, was the gentleman referred to as follows in the American Carpet and Upholstery Trade:

Sylvanus Sawyer, who died at Templeton, Mass., recently, was one of those old time types of New England inventors to whom the intricacies of machinery are a perpetual delight and pride. Outside of a number of small though useful inventions that he made, there are two that were of importance enough to give him more than a local reputation; and from them he, unlike many other inventors, realized enough to allow him to spend his last years in peace and in the pursuit of those studies in which he was wont to employ his spare hours while not busy at the work bench.

He came from good New England stock, his father being Malcom J. Sawyer, well known through the town, in accordance with the Yankee fondness for nicknames, as "Praying John" Sawyer. He was born in that place in 1822, his father living on a small farm and being by occupation a farmer and a stone cutter. In his early days Sylvanus showed a remarkable taste for mechanics, and was of a most ingenious turn of mind. He was hardly out of his teens when he had fitted up a little workshop on his father's farm, where his inventions were perfected later. The first invention of note was brought to perfection about 1850, and was a rattan splitting machine. Previous to this, the rattan from which the cane was made for seating "cane chairs" had been cut by hand—a slow and laborious process. The invention consisted of a head with knives so set that when the rattan was fed into the machine by rollers the strips were neatly cut off and curled up ready for use. This proved to be of great service in that section, where the chair business was the leading industry, and from its invention Mr. Sawyer realized largely.

Minor inventions occupied his attention for some years, and although all of them were of more or less value, it was not until about 1854 that he conceived the idea of a rifled cannon from which could be discharged an explosive shell. He had a cannon cast after this pattern in Fitchburg, rifled, and having a caliber about 3⅛ inches in diameter and 5 feet long. He then brought it up to Templeton and had explosive shells of an original and peculiar pattern made, they being grooved to fit the rifling of the cannon and give it that rotary motion now so universally used. The shell was hollow and in shape not unlike an acorn, and on its tip was an opening through which powder could be poured. A fulminating cap was the final arrangement, so adjusted that when it struck any object the contents of the shell would be ignited and an explosion take place.

When the test of his cannon was made (1854), his shell went straight to the mark and exploded with due precision, tearing the target into flinders. Thus successful was the first rifled cannon ball ever fired in this or any other country. Later, after many experiments, it was adopted by the War Department as an improvement of value.

Myopes.

Dr. G. Sterling Ryerson, Professor of Ophthalmology in Trinity Medical College, Toronto, says: Myopia being essentially a condition due to abuse of the eye, one is constantly obliged to say "don't" to patients. It occurs to me that it might be useful to put these prohibitory rules in aphoristic form:

1. Don't read in railway trains or in vehicles in motion.
2. Don't read lying down or in a constrained position.
3. Don't read by firelight, moonlight, or twilight.
4. Don't read by a flickering gaslight or candlelight.
5. Don't read books printed on thin paper.
6. Don't read books which have no space between the lines.
7. Don't read for more than fifty minutes without stopping, whether the eyes are tired or not.
8. Don't hold the reading close to the eyes.
9. Don't study at night, but in the morning when you are fresh.
10. Don't select your own glasses at the outset.

It would almost seem as though some of these rules were too obvious to require mention, but practical experience shows that myopes abuse their eyes just in the ways stated. Reading by firelight or by moonlight are favorite sins. Reading lying down tends to increase the strain on the accommodation, and while traveling tires the ciliary muscle because of the too frequent adjustment of focus. In short, anything which tends to increase the quantity of blood in the organ favors the increase of the defect, leading in extreme cases to detachment of the retina and blindness.—The Canada Lancet.