that enabled them to live in an atmosphere of carbonic acid. The accumulation of evidence goes to show that we cannot be too careful, not only in the quality of the air we breathe but also in the manner in which we draw it into our lungs, The nostrils are provided with a natural sieve and filter, and it is possible, on the principle of dialysis and the laws of the passage of gases through membranes, that the nitrogen and carbonic acid are excluded while the oxygen is permitted freely to pass. The warning of such authorities as Professor Tyndall and Dr. Stiles ought not to be disregarded, and we are disposed to concur in the sentiments expressed by Mr. Catlin, where he says: "If I were to endeavor to bequeath to posterity the most important motto which human language can convey, it should be in these words:

SHUT YOUR MOUTH."

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COMPARISON OF TURBINES WITH OTHER WATER WHEELS.

We find the following translation from *Weisbach's Ingenieur-und-Maschinen Mechanik,* in *Van Nostrand's Engineering Magazine,* for April, which sets forth the relative advantages of turbines and other wheels in a very strong light:

A great advantage of turbines compared with vertical water wheels is that they work with any fall from 1 to 500 feet (German), while the latter cannot convert into work the power of a fall of more than 50 feet. It is true that the ratio of effective work of turbines varies for different falls; for example, for small wheels it is less with high fall than with medium or low fall, because in this case the resistances are proportionally greater than with larger wheels under medium fall. On the other hand, overshot wheels obtain a modulus from high fall of from 20 to 40 feet, which cannot be reached by turbines. Equal amounts of work are to be expected from both kinds only from a medium fall of from 10 to 20 feet; but if the fall is low, then turbines in every case give a greater modulus than undershot wheels under the same conditions. Poncelet's wheel can be compared with turbines for falls of from 3 to 6 feet only.

Turbines have another great advantage over vertical water wheels, in working with equal effect under different heads, and especially in not being hindered by back water, so that they work in water as freely as in air, and in some cases with greater effect. Vertical wheels always lose power if the head varies, although in no great degree, unless the fall is low or the wheel is in the water.

On the other hand, variations in the overfall upon vertical water wheels are attended with less loss of work than is the case with horizantal wheels. In an economic point of view this fact is in favor of the vertical wheel. If it is necessary to increase the effect of a vertical wheel already in motion, especially if it is one upon which the water acts mainly by pressure, it is done by supplying more water; and to diminish the effect the supply is partly cut off; in neither case is the actual modulus greater or less. The relation is altogether different in the case of a reaction turbine. This works with most effect when the sluices are wide open and when the charge of water is the greatest; now if less work, and therefore less water, is required and the sluices are partially lowered, it happens that the work is diminished by decrease of supply, but partly by the loss of the living force of the water or by diminution of the head, so that the effective force is lessened. This destruction of living force may be compared with the braking or dragging of a wagon, which is applied in going down hill, when there is an excess of living force. Consequently, while the lowering of a gate only cuts off superfluous water from a vertical wheel, which can be used for other purposes, in the case of the reaction turbine the shutting off a part of the overplus subtracts from the living force of the other part remaining in the wheel.

In pressure turbines which do not run in water, so that the channels are not entirely filled, the modulus of work is more favorable, since the water issues through the channels without causing an eddy.

There is not a great difference between horizontal and vertical water wheels in respect to the change of the velocity of revolution; in both the normal velocity may be increased or decreased about one fourth without material loss of effect. But there is certainly a very great difference in the magnitudes of these velocities. All vertical wheels, with the exception of the undershot (Poncelet's especially), have a maximum velocity of from 4 to 10 feet, while turbines generally have far greater velocities, varying greatly according to the heads. For this reason, and because they have smaller radii, turbines generally make many more revolutions than vertical water wheels. It follows that the choice between these depends upon the number of revolutions; in other words, upon the kind of motion, quick or slow, which is required in the motor. But it must be borne in mind that rapid motion in a machine is rather injurious than advantageous, on account of the great increase of hurtful resistances, such as friction and shocks; for this reason it is often better to increase the number of revolutions by means of some machine of transmission, and to employ the vertical instead of the horizontal water wheel.

If the load of a machine is variable, as in the case of tilt-hammers or rolling-mills, the vertical wheel is to be preferred; for, though it runs slower, yet on account of its greater mass it acts more as a regulator than the turbine, whose variable motion must often be equalized by a fly wheel. But for a constant load preference must be given to the turbine in this respect; because vertical water wheels, especially if of wood, often have a so-called "heavy quarter," *i.e.,* equal parts of the circumference are not of equal weight.

In an economic point of view, turbines rank at least equal with vertical wheels; and for high and medium falls and a great overflow they are preferable because they are cheaper In respect to durability, also, the turbine must have the preference.

On the other hand, it must be remembered that turbines require a clear overflow, and that their effect can be hindered in a very great degree by sand, mud, moss, weeds, leaves, pieces of ice, twigs of trees, etc., which do no damage to vertical wheels. Finally, it is to be considered that turbines, particularly those with guide-curves, are more difficult to construct, and that departures from the mathematical rules of construction are followed by worse results than in the case of vertical water-wheels. This is the reason that so many turbines failed in the early trials, and that they are not yet as extensively employed as their advantages warrant.

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WHERE AND HOW CORKS ARE CUT.

We condense from the *Druggists' Circular* the present account of the way in which corks are manufactured.

In Europe the greater portion of corks are cut in the towns and hamlets in the immediate vicinity of the cork forests, and in the seaports of Seville, Barcelona, Oporto, Lisbon, Bordeaux, Lyons, Marseilles, and Gibraltar. In Germany the small homeopathic vial cork is largely cut, while it is safe to say that in most of the leading cities of the civilized world, cork-cutting is conducted as a branch of industry.

Throughout the whole cork-growing region the wood is cut by hand into the various sizes for use. For the common varieties, children are largely employed, while men of experience are engaged in cutting the finer qualities. After trimming the wood, slicing, and cutting into convenient-sized squares, the corks are cut, and then assorted in qualities and sizes. When assorted, they are then packed in bales varying from one hundred to three hundred and fifty gross each, and are then ready for shipment. In Germany they are frequently put up in small bails of twenty gross each. When cut in this manner the sizes must be judged by the eye, and there is consequently a lack of uniformity of size as well as imperfection in roundness of the corks. This will readily be seen by examining samples of imported hand-made corks.

Previous to 1855 all corks were cut by hand, and the exportation of corks from southern Europe was immense. Since the application of steam machinery to cutting corks in this country, the importation of foreign hand-made corks has rapidly declined.

About thirty years ago an attempt was made by an enterprising New Englander to cut corks by machinery, and an establishment for that purpose was constructed in Boston; but they failed to carry out the project successfully. As near as I could learn, the failure of the machine was in delivering the corks with smooth ends and with sufficient rapidity. In 1855 cork-cutting machines were constructed that proved successful, and since that time the trade has been revolutionized. It was soon proved that corks could be cut more uniform with less waste of material, and with vastly greater rapidity. An average day's work cutting by hand, and having the wood already cut to the proper-sized squares, would rarely exceed ten or twelve gross, though in a few cases the most expert workmen would cut nearly twenty gross; while an average day's work by machine would be one hundred gross, and a single instance was told me of a lad that had cut one hundred and eighty gross in ten hours. The number cut by machine per day will vary with the kind of machine, and the dexterity of the workmen, as also the quality of the wood. There have been quite a number of cork cutting machines introduced from time to time, but I believe they are all of two general styles. The kind most largely used (I believe) is the punching and boring machine, originally invented by J. D. & W. R. Crocker, of Norwich, Conn., and since improved by them and others. This original machine cut only straight corks. Another machine was afterwards added which cut the taper cork. There have been some modifications of the machine and adaptations by other manufacturers, but it is believed that the credit for introducing steam machinery for cutting corks is due to the Messrs. Crocker. There are others who are entitled to praise for judicious modifications, but the writer omits names lest he should do injustice to some whose names are not known to him.

The principles of the two styles of machines used may be of interest, and I shall endeavor to explain them as clearly as possible. In the punching or boring machine there is a sharp steel cylindrical knife, revolving horizontally, being propelled forward to the block of cork-wood to be cut, and backward again, as rapidly as the skill of the operator desires it. The knife cuts through the block of cork-wood, and the cork cut by the operation passes through the cylinder and is carried off out of the way of the operator. This machine cuts only a straight cork, and it is ready for sale without any further operation, except sorting out those in which the wood is imperfect. There is another boring machine which bores at one operation a taper cork, but requires a separate handling to remove the cork from the block. The tapering machine alluded to previously has either a square of cork-wood or the round straight cork inserted in an adjustable lathe (which is a part of the machine) in which it revolves rapidly; it is then presented to the blade of a flat circular knife, from 24 to 30 inches diameter, which lies flat and revolves about five or six hundred times a minute. Two or more revolutions of the cork are made, which removes a thin shaving and gives the requisite tapering shape to the cork. This tapering machine is adapted to cut either a straight or taper cork, as it needs only a very slight alteration of the adjustable lathe to cut either style of cork. There are some minor details, but a five minutes' examination of the machines would convey more information than pages of written description. It is an exceedingly interesting mechanical operation, and those who have not seen it should embrace an early opportunity to do so.

In cutting the wood into corks, it is first steamed for a short time, then by a circular knife cut into strips suitable for either the length or breadth of the cork. If the boring machine is used, the smooth side of the strips is then introduced, and the corks are at once bored out as closely together as can be done. The corks need only sorting, to reject imperfect ones, when they are ready for sale. These corks are straight. If it be a taper cork, the straight ones are now introduced into the adjustable lathe of the tapering machine before alluded to, and a somewhat conical shaving is taken off, when the corks are sorted and put up for sale. It is asserted by those using this machine, that it is the most advantageous and economical. When the boring machine is dispensed with, the strips of cork-wood are cut into suitable squares by hand, and at once cut into either straight or taper corks by simply adjusting the lathe which holds the cork.

The corks, when offered for sale, are usually designated by numbers fron one to twenty, and in addition are called straight or taper. The largest number of any one sold are those suitable for ale and soda-water bottles, while the vial corks of various sizes, except the two smallest, are in nearly equal demand. Of the other styles of corks, there are flat or specie corks of various sizes, enlarging by one-eighth of an inch.

In the manufacture of corks fully one-third of the wood is wasted. This arises from inequalities and imperfections in the wood, and the natural wastage in cutting circles out of any plane surface. This wastage has found some uses, among which the principal are in filling cushions, mattresses, the spaces between the roof and top ceiling of houses, as also the spaces in the sides of frame houses and buildings for storing of ice, while in the cork factories the coarser wastage is used for fuel.

Foreign hand-cut corks are now in a great measure being superseded by American machine-cut corks, as they are much more uniform in size and quality, and can compete successfully in price.

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A MANUAL OF ELECTRO-METALLURGY. Including the Application of the Art to Manufacturing Processes. By James Napier, F.C.S. Fourth American from the Fourth London Edition. Revised and Enlarged. Illustrated by numerous Engravings. Philadelphia: Henry Carey Baird, Industrial Publisher, 406 Walnut street. Price, by mail, free of postage, $2·00.

This work treats of electro-metallurgy in both a scientific and practical manner. It is, as its title imports, a complete manual upon the subject. It commences with a history of the art, brought up to date. This is followed by a description of the various galvanic batteries, with their peculiarities and their applicability to electro-metallurgic operation. The miscellaneous applications of the process of coating with copper are next treated, after which follow in their order discussions of the various methods of bronzing, deposition of metals upon one another, electro-plating, electro-gilding, results of experiments on the deposition of other metals as coatings, theoretical observations, etc. The value of the book is enhanced by a copious index. So far as we can infer from an examination made with special reference to detect omissions of recent processes and discoveries, the work is brought entirely down to the present state of the art.

MODERN WORKSHOP PRACTICE. As Applied to Marine, Land, and Locomotive Engines, Floating Docks, Dredging Machinery, Bridges, Shipbuilding, Cranes, etc., etc. By John G. Winton, Engineer. Strahan & Co., Publishers, 56 Ludgate Hill, London.

This is one of Weale's Rudimentary Series, intended to treat in a popular style, and in a practical manner, the departments of mechanical engineering named in its title. These subjects are viewed almost entirely from an English standpoint, yet the book contains much valuable information to the American engineer. A valuable feature of the work is found in its tables, the use of which will save much time and labor in calculations of all kinds pertaining to proportions of boilers and engines, bridges, etc.

ELECTRO-METALLURGY PRATICALLY TREATED. By Alexander Watt, F.R.S.A., Lecturer on Electro-Metallurgy, etc., formerly one of the Editors of "The Chemist." New Edition. Strahan & Co., Publishers, 56 Ludgate Hill, London.

This work, besides treating in a plain and specific manner with the difficulties and the various modes of procedure connected with electro-metallurgy, gives much additional matter not contained in former editions, upon the production of a dead white surface on silver articles, whitening brass dials, coloring gold articles, reduction of solutions, etc, etc. This work will be found a great aid, not only to amateurs, but to the professional electro-metallurgist.