boat, as regards leakage, can be seen. A glance at the scale is sufficient to reveal whether the water is gaining or diminishing in quantity. The attention of boat-owners, forwarders, underwriters, and the canal administration, should be directed to this improvement as lately patented, and if it be such as these committees and its friends claim for it, they should secure its early adoption.

Patents in this country and Great Britain have been secured through the Scientific American Patent Agency. All further information can be had by addressing Dr. O. Reim, Springfield, Ohio.

CONCERNING MELODEONS AND THEIR MANUFACTURE.

It is difficult to conceive of two things more antagonistic than music and mechanism. In the first we have melody, in the second discord. Of course in speaking of music we *mean* music; not the remorseless agitation of an instrument which poor players inflict upon persons unfortunate enough to be in their vicinity. The genius of man is capable of almost anything, and this assertion is well illustrated by the improvements which have been made in the melodeon of late years by Messrs. Carhart, Needham & Co. We were especially struck with this fact by a recent visit to their factory, in Twenty-third street, in this city. Ordinarily but little mechanism is used in the construction of musical instruments. By this we mean machines for special purposes. There is not a workshop in the land but what uses iron and wooden planing machines, etc., and these are as common as knives and forks in households. For really ingenious and labor-saving machinery, which will do in half an hour sextuple the amount that a man could, commend us to Carhart, Needham & Co.'s workshop.

It is a pleasure to go through it. For those who admire the skill and cunning which can put pieces of iron and brass together so that they are not machines, but great inspirations—like paintings or poems—this factory will have charms. The tools are not melodious in their nature, but they make music, and there is nothing to remind the reader in his rounds that he is witnessing anything else than the ordinary transactions of a factory. We have been at some pains to obtain facts in regard to the melodeons made in the works alluded to, and the result of our researches is here presented.

THE REED.

A melodeon is in all essential points an accordeon upon legs. The sound is produced in the same way, and by the same agents, namely a current of air, driven with greater or less velocity, through a brass block, having a brass tongue fitting an opening in

Fig. 1

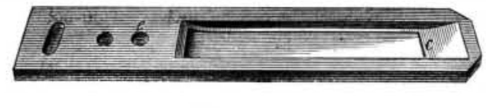
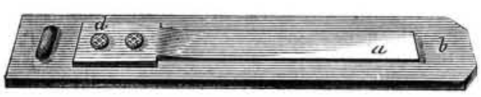


Fig. 2

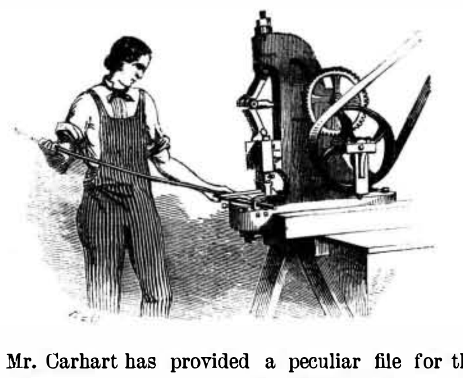


the same, as in Fig. 2. The reed itself is *a*, or the small tongue of brass, and this is set in a block, *b*, called the reed-block. Other points will be alluded to hereafter. It is merely the vibration of this reed that makes the sound, and the order of the sounds, the melody. The wires strung along the telegraph routes vibrate in high winds, and the tone or key is regulated by the force of it. In fitful gusts the wires breathe as softly and sweetly as an eolian harp, and an imaginative person might say that it was a fitting refrain to the sorrowful details of battle and of sudden death which they convey.

These reeds, therefore, make music by vibration, and though the initiated may deem it a simple thing to dwell upon, the unprofessional reader will be glad to know that the reed which gives the tone, C, or pitch, C, as it is called, vibrates five hundred and twelve times in a second. In doing that it rises nearly $\frac{3}{16}$ths of an inch, and consequently travels in one minute upwards of 450 feet, or as far as the piston of a steam engine in the largest of our river steamers. These details illustrate popularly some of the physics of music.

It is in the elaboration of this little reed-block and the reed that the greatest ingenuity has been exercised. The raw material of the reed is simply a strip of sheet brass, a full tenth of an inch thick, some two or three inches wide, and several feet in length. The operator takes this strip in convenient lengths for handling and puts it under the die of a press, as shown in the engraving. This die cuts out one blank, which is simply a flat bar of brass. The bar then goes to a machine, invented by Mr. Carhart, which planes the edges and one face. From this machine it passes to another which cuts the slot in the block. These processes occur very rapidly.

The slot in the reed-block is made by a small circular cutter, also in a machine, which we have no space to describe at length. Every mechanic knows that in cutting through a thin plate of metal with a circular cutter a thin fin, or jagged edge, is left at the ends where the cutter enters and stops. To remove this edge by an ordinary file is no great task if one has plenty of time; but in order to make musical instruments at a low price they must be made quickly, and therefore elaborating a small orifice like the one mentioned is too costly.



Mr. Carhart has provided a peculiar file for this purpose, which is a very curious thing in itself. We shall not excite the reader's curiosity any further, for details respecting it are contraband, and cannot be published. It is so economical and efficient, however, that the greatest benefit has been received by the inventor from its use in his work.

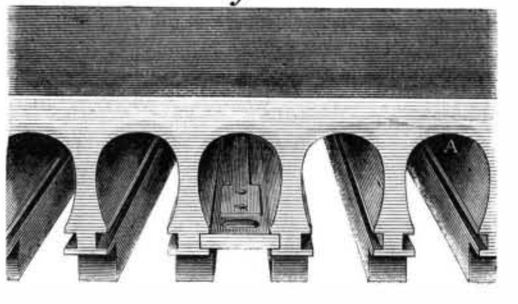
The reed—or as the the uninitiated would call it, the tongue—is also peculiar. In former times it was punched out. Experience has proved, however, that punched reeds are not durable. The metal is condensed so much about the base of the reed (where the square shoulder is) that the cohesion of the particles is destroyed, and the reed breaks at the place designated. The improved practice is to saw them out by means of a series of delicate cutters set in a wheel. This process takes more time than punching, but a much better piece of work is produced.

When the reed is sawed out it is riveted on to the block by another machine, which, although insignificant in its appearance, has worked a complete revolution in this branch of making melodeons. The appearance of the rivet head can be noticed by referring to Fig. 2, at the commencement of this article. It will be seen there that there are two raised heads, *d*, crossed with lines. These heads are portions of metal pushed up out of the reed-block, as at *e*, in Fig. 1; there is no pin or solid rivet in the reed or its block, and the saving of time in punching holes, cutting off the pins, putting them in and closing them, as practiced in the old method, is apparent at once to the professional reader.

After the reed is in its place in the block it is planed on top. The thickness of the reed is less at the base than at the free end, and the tone of the reed is determined by this planing. So accurately does this planing machine work that the reed, when delivered finished from the machine, is within a sixteenth of a true note, and requires only a little adjustment to make it perfect. When we add that the tuner, in giving the reed its proper pitch before it is finally placed in the instrument, uses a smooth file, and that *one rub* of this file is sufficient to alter the tone materially, it will be seen that the machine must be very nicely adjusted to make the reeds correct, or nearly so, at first. We cannot dwell longer upon the reed, however, interesting as it is; the tubeboard, or that detail of the instrument which receives the reed-block, demands attention; viewed as the product of machinery it is marvellous.

THE REED BOARD

Fig. 3



is simply a strip of plank, the length of the key-board full of little cells, as shown in Fig. 3. In each of these cells there dwells one of the reeds we have seen made, and under the bottom of the cell there is a valve placed with soft kid.

Now as the performer works the bellows by his feet he produces a vacuum therein. So when his nimble fingers press the ivory keys before him, the valve alluded to opens, and the air rushing down upon the reed below makes it vibrate most rapidly. This is the mechanism of music, and the Oratorios of Handel, the "Creation," "the Deluge," and others, are in reality reduced to certain mechanical movements. So many blasts of the bellows, so many keys pressed upon at such and such times, will produce some of the most exalted and refined emotions in the human breast that the soul is capable of receiving.

The cells, or tubes as the makers call them, where the reeds set, are all made by a most ingenious machine, contrived by Mr. Carhart. This machine is automatic, and the strip of plank out of which the board is made, having been placed in a certain position, the cutter goes on and produces all the cells, as at A, and performs its office with a regularity and exactitude which is almost human. This machine will rank with the automatic lathe of Blanchard; for it is not only capable of executing work in straight lines but also carves scrolls for lyres, and similar work, with such nicety and rapidity that no hand-work can approach it. The cutters revolve with great velocity, 7,700 times a minute, and the speed of the driving belt is just one mile in a minute.

There is another little detail in this reed-board which commanded our attention, and this is the small groove the reed-block sets in. This groove is about a tenth of an inch wide and deep, and is made by a swiftly revolving cutter. Each groove is an exact fac-simile of the other, and those made years ago will fit any reed-block made to-day. One of these tube boards is cut in five minutes, and the rapidity with which the details are executed is worthy of notice.

Another discovery of Mr. Carhart's—that of bending the reed to enhance its tone—voicing it as Mr. Carhart says—is one which has proved beneficial to them and very much enhanced the character of these melodeons for sweetness and power. Fifteen years ago the reed instrument was very generally despised. At the present time there are over 20,000 melodeons made annually on the plans of Mr. Carhart, involving principles for which he has obtained patents.

It is not alone from this utilitarian point of view that the improvement of the melodeon and reducing its cost by introducing machinery has been valuable to society. By directly giving to the masses opportunities of cultivating a musical taste (which tends to refinement of soul more than any other accomplishment) very much has been done towards elevating and ennobling them. We stood by the side of one of these reed organs in the sales-room, and heard one of the most skillful players in the country test it. The room itself was hard, angular, and devoid of grace; but just about the instrument, as the player touched the keys, there was an atmosphere full of tranquility and of peace. It was easy to understand why the spirit of devotion in a church is aided by music, or the education of children rendered more pleasant where the melodeon or piano is introduced. The slow and solemn notes of praise rose in rich harmony from the brazen reeds as they trembled soft and low with the air current flowing through them. Sonorous, full-bodied, flute-like tones, that emulated the wind among the pines in June, or the laugh of a trout brook rippling over its graveled course.

Ancient mythology speaks of the statue of Memnon, which, as the first rays of the morning sun fell upon it, gave forth sweet music, so that the people in that age believed it to be inspired, and forever wondered at the cause of the sounds. There may have been a reed inserted in the mouth of this statute by some cunning craftsman of the period, having a valve which opened by expansion or the heat of the sun's rays; this once accomplished, the morning air breathing through pipes would cause the reed or reeds to give forth airs. Be this as it may (mere speculation on our part) the reeds that Messrs. Carhart, Needham & Co. make, discourse music enough, if the skill of the performer is equal to the quality of the instrument. And in both hearing and seeing the wonders of this factory we consider that our afternoon was well spent.

Correspondence

Mariotte Law---Expansion.

Messrs. Editors:—The well-known law of pneumatics is simply this:—If you take a vessel holding one cubic foot of air, and with sufficient pressure you diminish the volume of air to one-half a cubic foot, you have two quantities of air in one space; or, as it is usually expressed, you have a pressure of two atmospheres. If you take the mercury column in a barometer as the measure of pressure, the atmosphere supports a column 30 inches high, and two atmospheres occupying one space will support a column of mercury 60 inches high—and so on for three, four, or more quantities. Hence the axiom, "double the pressure is half the volume;" but should the air be quickly compressed there would be an increase of temperature from the compression of the heat (or molecular action) contained in one volume of air, and, consequently, there would be a little more than one-half the volume for double the pressure until the temperature was the same as the original volume that was compressed. Now take this quantity of compressed air and suddenly remove the pressure, and it would not quite be double the volume, but after the temperature had been acquired of the original quantity, it would be exactly double the volume.

The foregoing statement is the complete definition of the much-talked of "Mariotte law." The only plausible way that this law can be applied to steam is as follows:—One cubic inch of water will make one cubic foot of steam at the pressure of one atmosphere, or it will make one-half a cubic foot of steam at the pressure of two atmospheres—and so on; by doubling the pressure it will make half the volume nearly.

The actual proportions of volume and pressure, according to the tables published by Pambour, Lardner, Brande, and others are one cubic inch of water at—

1	atmosphere	pressure	makes	1,669	cubic	inches	steam
2	"	"	"	881	"	"	"
4	"	"	"	467	"	"	"
8	"	"	"	249	"	"	"

whereas, if the Mariotte law perfectly applied to steam, the volumes would be for 1 cubic inch of water at—

1	atmosphere	1,669	cubic	inches	steam
2	"	834·5	"	"	"
4	"	417·25	"	"	"
8	"	208·125	"	"	"

So that 417 cubic inches steam at four atmospheres' pressure does not have water enough to make 1,669 cubic inches of steam at 1 atmosphere by 12½ per cent. nor 208 cubic inches steam at 8 atmospheres by nearly 25 per cent.

That 467 cubic inches steam, at 4 atmospheres' pressure would, on gradually removing the pressure to one atmosphere, enlarge itself to 1,669 cubic inches, had not, as far as it was possible to learn, been determined experimentally up to the year 1860. During that year it was tried in an apparatus suggested by myself, the tables of which I may furnish in a future paper.

The application of the Mariotte law to the use of steam expansively is stated in the "Treatise on the Steam Engine by the Artisan Club," edited by John Bourne, London, 1849, as follows:—"If the steam valve be closed when the piston has descended through one-fourth of its stroke, the steam within the cylinder will exert one-fourth of the initial pressure at the end of the stroke, ... and, as a summary of the ascertained effects of expansion will induce a more careful examination of the principle at a future stage of our progress, we may here set down some of the most notorious. Let the steam be stopped at ½ the stroke its performance is multiplied—

		1·7	times
at 1-3	stroke	2·1	"
" 1-4	"	2·4	"
" 1-5	"	2·6	"
" 1-6	"	2·8	"
" 1-7	"	3·0	"

To reduce the statement of Bourne to a correct comparison with Pambour, it stands thus:—1 cubic inch of water makes 281 inches steam at the pressure of 7 atmospheres; now this expanded 7 times ought to make $281 \times 7 = 1{,}967$ cubic inches steam at one atmosphere; whereas one cubic inch of water at 1 atmosphere pressure makes only 1,669 cubic inches steam—a deficiency of near 20 per cent. I remark here, that it is not known that Bourne ever tried one single experiment, or knew of one that verified these "notorious facts;" they are mere theoretical hypotheses.

Let us now look at Regnault's statements of the motive power of elastic vapors. He knew all about the Mariotte law, but he says (London and Edinburgh *Philosophical Magazine*, October, 1854): "According to the views which I have adopted regarding the mode of generation of the power in machines moved by elastic fluids, the motive power produced by the expansion of any elastic fluid is always in proportion to the loss of heat undergone by this fluid in the part of the machine where the power is produced. During the last few years several distinguished geometricians have endeavored to deduce this principle from abstract considerations founded upon hypotheses of greater or less probability. For my own part I have long labored to bring together the experimental data by means of which the theoretical motive power, produced by a given elastic fluid, which undergoes a certain change of volume, as well as the quantity of heat which becomes latent in consequence of this change, might be calculated *à priori*. Unfortunately these data are very numerous, and most of them can only be determined by extremely delicate and difficult experiments."

Herein is the difference between air and steam, if a cubic foot of air at two atmospheres' pressure be contained in a tight vessel for a thousand years, it will give out its elastic force on removing the pressure, while a cubic foot of steam must give out its force in a few seconds, or else its force is entirely lost. Also the relative volumes of air at different pressures, of which the Mariotte law is the exponent, depend on the same temperature; whereas the different pressures of steam depend wholly on different temperatures; for instance steam at the pressure of—

1	atmosphere	is 212°	Fah.
2	"	" 250°	"
3	"	" 274°	"

Now the slightest increase of pressure at these temperatures, or slightest decrease of temperature at these pressures, will turn the whole of the steam to water; while an increase of pressure on the air will only diminish its volume to the amount due to that pressure.

The modern received opinion promulgated by Joule, that heat is converted into force in the steam engine, is in accordance with the statement made by Regnault, that the amount of power developed by the expansion of any elastic fluid is always in proportion to the loss of heat undergone by this fluid in the part of the machine where the power is produced. The quantity of heat, or, as it is expressed, the "total heat," as ascertained by M. Regnault from actual experiment, in a cubic inch of water in steam at—

1	atmosphere	pressure is	1,178° Fah
2	"	"	1,190° "
4	"	"	1,203° "
8	"	"	1,218° "

If the force is all a heat-force, and it is properly applied in moving the piston of a steam engine, and as it is not possible to increase this heat by expanding the steam, it would seem as if some of the modern theorists are endeavoring to make out that the steam can work three or four times over, or, as some of the most enthusiastic say, "expand a thousand times." The experiments of Regnault, to determine the theoretical motive power of expansion, being "extremely delicate and difficult" are not applicable to so rude a machine as a steam engine, they of course furnish no rule to calculate the motive power produced by expansion in a steam engine.

We are finally left to recent experiments on the steam engine itself, and these, so far as they have been fairly tried, show that the "notorious" multiplying of its performance by expansion is founded upon "hypotheses" of no great probability.

W. Rowell.

New York, June 22, 1864.

THE LAST MEETING OF THE POLYTECHNIC.

The Polytechnic Association of the American Institute held its last meeting for this season, on Thursday evening, June 16, the President, D. S. Tillman, Esq., in the chair.

THE FLOW OF WATER THROUGH PIPES.

Mr. Root described an experiment which he had tried to ascertain the effect produced on the flow of water through pipes by dividing the pipes with perforated diaphragms. In a three-inch tin pipe he inserted ten diaphragms at equal distances with a hole three-fourths of an inch in diameter through the center of each diaphragm. The pipe was perforated on the upper side by a minute hole in each space between the diaphragms, and water was admitted under a head. The jet from the minute opening nearest the end of the pipe where the water was admitted rose to the hight of ten inches, the next jet to the hight of nine inches, the next to the hight of eight, the next to seven, the next to six, and so on to the last, where the water rose one inch, and it flowed out of the three-quarter opening at the end of the pipe without any projectile force, falling perpendicularly.

Mr. Dixon explained that the obstruction in the flow of the water was caused by eddies formed between the diaphragms. He described an experiment tried in Jersey City of making enlargements in a pipe, and it was found that four or five enlargements diminished the flow of the water sixty per cent.

PAPER FROM CORN HUSKS.

The regular subject for the evening, "The Utilization of Waste Products," being called—

Mr. Watson presented some samples of paper and cloth made of corn husks by the process of Moritz Diamant, as improved by Dr. J. C. Schaeffer, and Dr. Auer von Weisbach, all of Austria. As this process will be fully described in the Scientific American, we occupy no further space with it here. In the discussion which followed—

THE WAY ITALIAN PEASANTS EAT,

was described by Professor Joy. He said that in riding by the fields in the morning you would see a large kettle of Indian meal and water boiling over a fire in the field. When the mush is cooked it is poured out upon a large flat stone, when the men, women and children gather about, and take it up in their hands and eat it. At noon you will see the same process, and at night the same. They eat little else than mush. At first there was a prejudice against the American corn, as they call it, but now it is almost the only article of food among them.

The time having arrived for the usual summer vacation, the Association adjourned to the second Thursday in September.

Miniature Engine.

The Philadelphia *Ledger* thus describes a small steam engine exhibited at the Sanitary Fair, in that city:—"The old "Curiosity Shop" has had an addition to its wares in the shape of a miniature steam