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 281×7=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