from top to bottom the whole body of bone black in the filter, is not allowed to run out at the bottom through the pipes W Y; the cock, V, being kept closed so as to force it to ascend through the upright pipe, U, from whence it is allowed to flow out through the open cock, H.

This arrangement prevents a filter from ever running dry, as it will necessarily always remain full of juice to the level of H.

The juice is received in a moveble funnel, T, which fits on the upright pipes, R and Q. If juice is being run through the filter, the funnel is placed on R, and is thus conveyed either directly to a tank, to a *monte-jus*, or to the evaporating pans, according to the disposition of the works. If sirup is being passed through the filter, the funnel is placed on Q and run to the concentrating pans, either directly or through a special *monte-jus*.

When not in use, the top orifices of the pipes, R and Q, must always be carefully closed by metallic plugs. The accidental introduction of foreign substances into these pipes would cause very considerable trouble, loss of time, and expense.

As in some cases it is necessary to filter the same solution twice over, a communication is often established between contiguous filters by means of a special system of pipes and cocks.

In our figure, V is used for running water into the pipe Y, which carries it off as waste, or which conveys it to the bone black department, where it is used in the process of "fermentation," which we shall describe in due time.

Filtration of the whole of the products undergoing the processes of manufacture takes place normally twice before crystallized sugar is produced from it. The first filtration is that of the carbonated juice; the second of this juice, after it has been subjected to evaporation, until it has reached the consistence of a thin "sirup." The working of the filters in a battery being simultaneous for both juice and sirup, and to a certain extent combined, the same filters being first used for sirups, and subsequently for juice, we shall reserve our account of the *modus operandi* of filtration in general until we shall treat of the purification of sirups.

After leaving the filters, the clear juice is conveyed to the evaporating pans, where it is reduced to a certain degree of consistentency, "sirup," after which it has to be filtered a second time, as we have already said.

Evaporating pans in the olden times, were simple contrivances, and consisted in open boilers, either heated by the direct action of fire or by steam passing through double bottoms, or coil pipes. Some small sugar factories still use this latter system, which is wasteful in fuel and makes sugar of a more inferior quality than is done by the more perfect appliances of our day, known as the "triple effect vacuum pans."

It would be tedious and unprofitable for us to sketch the history of the gradual progress in the perfection of vacuum pans, from the primitive Rillieux "double effect pan" to the more perfect "triple effects" now in use. We shall consequently limit ourselves here to the description of one of the best known, "Robert's pan," which, if well understood, will permit the reader to readily comprehend the working of all others, no matter what modifications or improvements they may present. Let us add, in this respect, that the original Robert vacuum pan is hardly to be found in any manufactory unless it has been more or less altered in some details of its construction. Before explaining the use and advantages of the vacuum pan, we give a description of its various parts, which will facilitate our task.

Fig. 1 is a side view of the whole apparatus. The three pans, or bodies, are marked I, II, III, the three intermediate vapor columns are numbered 1, 2, 3. A is the pipe which carries the juice into the first body. B C is a pipe which carries the juice from the first body to the second, and G F, another which conveys it from the second to the third body, from whence the pipe, F, takes it to the *monte-jus*, G. H is a pipe through which the pans can be entirely emptied. I is a pipe communicating a vacuum from the condenser to the *monte-jus*. K is a pipe and valve for introducing the steam for heating into the first body. K' is a pipe for running off condensed water. L M is a pipe for conveying spent steam and condensed water to the condenser, N. O is the injection pipe of the condenser. Q is the outlet for the hot water of condensation. P is a glass indicator for the hight of the juice in the pan. R is the apparatus for sampling, in order to learn the density of the juice. S represents the glass bull's-eye for observing the progress of ebullition. T is a small funnel for the introduction of melted fat to arrest too violent ebullition. T' is the small cock for admission of air. U is a thermometer indicating the temperature of the boiling juice. V is a special barometer for low pressures for determining the degree of vacuum. X is an indicator for the water accidentally collected in the columns. Z is the pipe for running out the liquid which has found its way into the column.

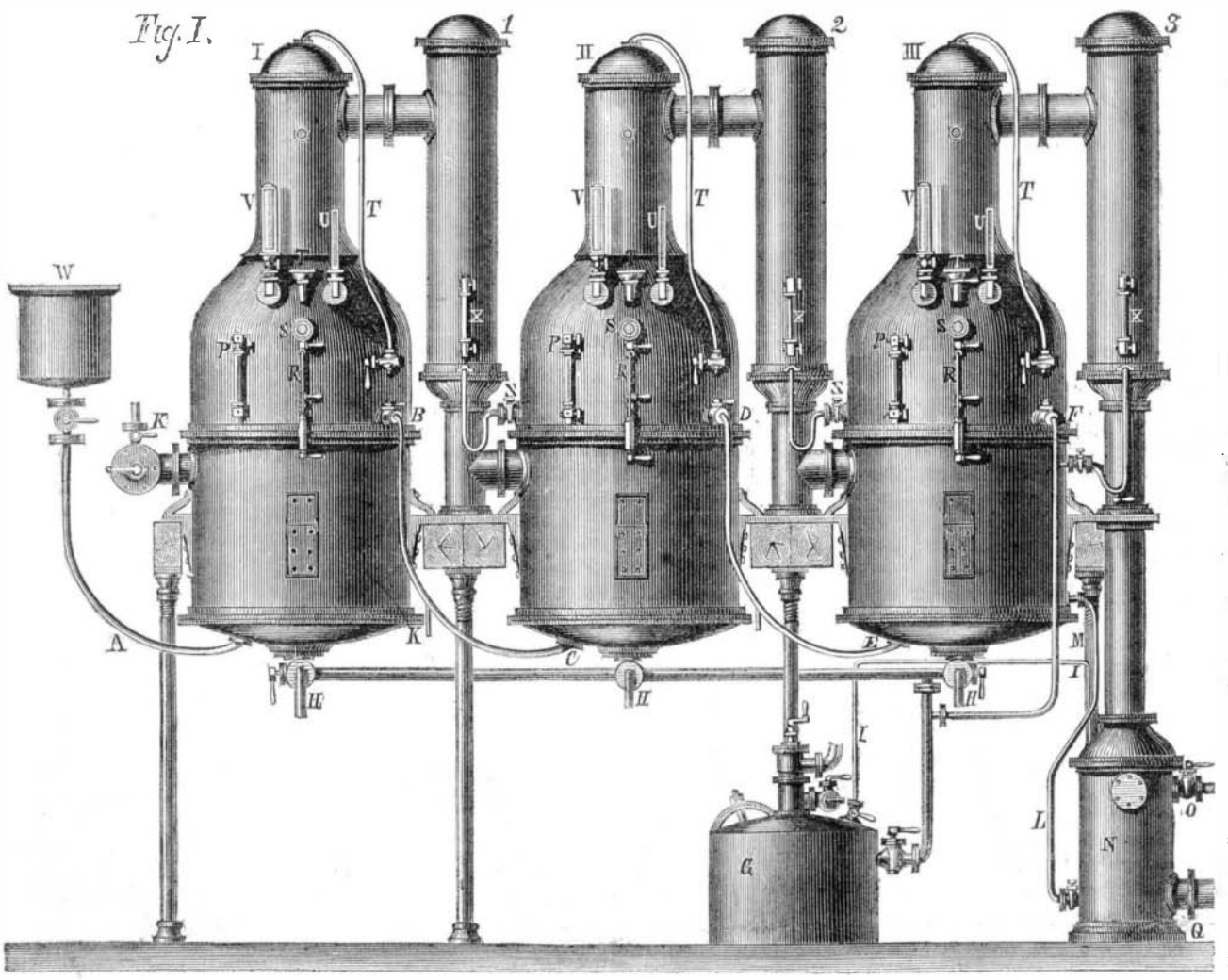
A man-hole is constructed in each body, but not figured in our cut, as it is placed at the back of the pan, as here exhibited.

Fig. 2 shows a section through the last body of the above apparatus, so as to give a view of the internal arrangement of a vacuum pan.

The lower portion of the body, III, shows the disposition of the tubes, around which the steam for heating the juice circulates. These tubes are inserted at both extremities into perforated end plates. The space above the top plate is the steam or vapor chest, where the vacuum is formed, and the steam of the boiling juice collects before being carried off. N is the condenser; O its injection pipe; M the exit pipe for heated condensation water, which is drawn off by an air pump; A is an upright pipe surrounded by an empty space, B, in which accidental water and liquid collects.

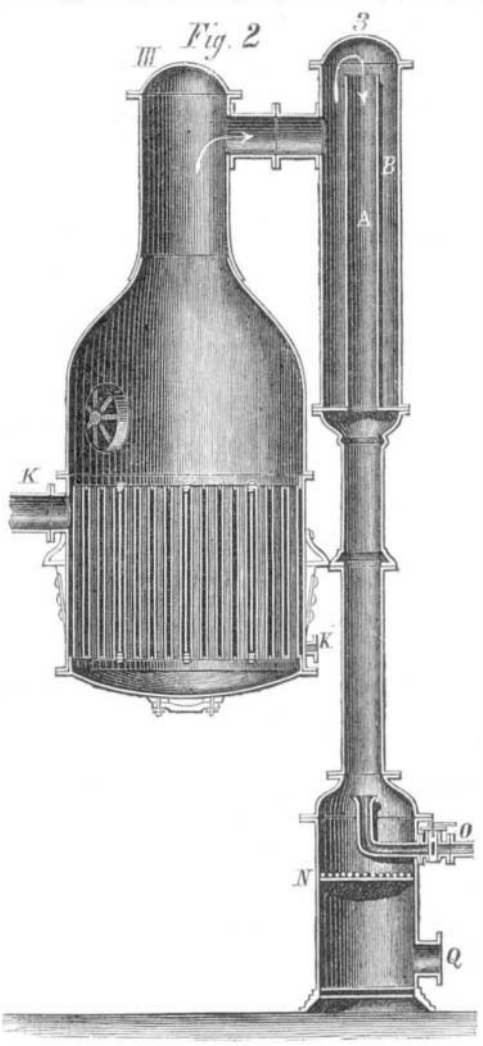
In our next article we shall furnish a concise exposition of the theory and practice of the working of the triple-effect vacuum pan.

Fig. 1.



ROBERT'S TRIPLE-EFFECT VACUUM PAN.

Fig. 2



The Spring Freshets.

It is said that the spring floods of 1869 have been unusually destructive. On the Connecticut river, the height of the water has only been exceeded four times in the last seventy years. In Hartford, the water on April 23d, at noon, was 26 feet 8 inches above the low water mark. In 1854, the gage marked 30 feet. In Canada, the ice began to move out of the St. Lawrence on the night of April 22d, and the towns along the banks were seriously damaged, houses and embankments having been swept away and several lives lost. In New York State, along Black river and the lower part of Lake Ontario, the floods were very violent. Factories, tanneries, dams, and flumes were carried off. Near Watertown, a boom, restraining several acres of timber and flood wood, broke away from the chains, and carried off railroad bridges, mills, factories, furnaces, and machine shops. In the John Browntract, the flood was caused by the breaking of a heavy dam, built to restrain the water of a series of lakes, and forming a feeder to the New York canals. Near Utica, the State dam, at a reservoir covering 500 acres, gave way, and the flood destroyed mills and other property valued at $100,000. On the Hudson and Mohawk rivers, the inundations have been very extensive, and the streets of Albany, Troy, and other cities in that vicinity, have been covered with water several feet deep.

WOOD ENGRAVING---ANCIENT PROCESS.

The exact origin of wood engraving is enveloped in considerable doubt; it is of very ancient date however, and the best authorities on the subject agree that it dates back some centuries anterior to the Christian era. It is useless to speculate upon fancied theories; for all practical purposes it is only necessary to present a skeleton review of the art, in its primitive days, or that portion of it that can be gleaned from reliable sources. Even this would be superfluous in this connection, except that it affords to practical mechanics, and those interested in the art, an opportunity of contrasting the means and appliances employed in the olden time, with those of our modern day.

According to the best authenticated authority, wood engraving, as an art, was first followed in (European countries) in Italy, about the middle of the fourteenth century, one of the early specimens of which is presented in Fig. 1, representing "The Knave of Bells."

This specimen is traced to one Antonio Carrigi, a manufacturer of playing cards in Venice, where, at this time, card playing as an amusement, and also for gambling purposes, was indulged in by the nobles and wealthy classes. These

rude cuts were afterward painted in several gaudy colors with a pencil and sometimes ornamented with gilded borders. Although Carrigi may have been the first to follow the business of wood engraving in Europe, specimens of the art were occasionally met with that were supposed to have been executed many years previously; their exact origin never could be traced. For centuries anterior to this period, wood engraving was known to have been practiced as an art among the Chinese people, who have always been recognized as the most ingenious artisans in the world, in a number of the mechanic arts. The civilized or Christian nations, however, were not allowed to benefit by their ingenuity. An insurmountable barrier was ever interposed, precluding all communication with the outside world of the Chinese Empire.

China was not alone in giving birth to those works wherein mechanical skill was evinced at a very early period of the world's history. Late discoveries made in excavated catacombs in Egypt, and similar discoveries made amid the ruins of Herculaneum and Pompeii, also lead to the conclusion that wood engraving was known and practiced centuries before its new advent in Italy. It is therefore reasonable to suppose that with the decline and destruction of those countries, in which many of the higher branches of the mechanic arts, had reached the zenith of their perfection, they perished with them.

In historical annals there is a wide gap in their art records, a lapse of ages ere the skill and ingenuity of man is said to have revived and re-invented many of the arts, sciences, and manufactures, thus lost to mankind. Even tradition furnishes nothing but a faint glimmer of objects that lived and had their being in the past, and have left nothing to posterity but the wrecks and ruins of their former glories.

True, occasional relics reach us of the present day, affording a faint reflex of what once existed in the palmy days of this or that country, but they have served to gratify a passing curiosity only, or, it may be added, to stimulate the efforts of mechanical geniuses to reach even a higher scale of excellence.

The parchment scrolls lately excavated from mounds in the neighborhood of the Pyramids in Egypt, present many curious hieroglyphical and other characters which leave no room for doubt that the impressions were made from blocks of wood. It is impossible to fix a time when these were executed. In the same way with occasional specimens of a similar character, of Chinese origin, exhibited in cabinets and museums in European cities; their antiquity is simply a matter of speculation.

As we are cut off from any data previous to the fourteenth century, when wood engraving as an art was first adopted in Europe, we are compelled to accept the above theory.

In its application to books the earliest accounts that can be traced are in the first quarter of the fifteenth century, when engraving on wood was applied to the multiplication of copies of religious designs, which were at this period in demand among the people of Italy and Germany. This demand was created from the establishment of a number of monasteries and other religious institutions in these two countries, and a consequent demand for the reproduction of manuscripts of a devotional character. Strange to say, the demand for playing-cards, about the same time, led to the employment of a number of artisans who engaged in the business of wood engraving; religion and its antipodes, in this regard, being in perfect accord.

The story retailed by certain history manufacturers that the first wood engravings known in Europe were executed by a brother and sister of a noble family of the name of Cunio, in 1285, representing the actions of Alexander the Great, is without the slightest foundation. Montague tells us that the sister, who had a talent for drawing, may have sketched some designs on tablets of wood, then used as slates are in our modern schools, representing in a crude form, Alexander in some of his heroic exploits; and that the brother may also have cut into the lines, thus drawn, with a stiletto or sharp instrument, as school boys are in the habit of cutting letters animals, etc., with their penknives, on walls, fences, etc. It was not until late in the fourteenth century that the Venitian merchants were allowed to have commercial intercourse with the inhabitants of China. It is fair to suppose therefore that in that part of Italy bordering on the Adriatic, specimens of wood engraving brought over from China by the trading argosies, were then seen for the first time. This agrees with the time when Carrigi is said to have inaugurated the art of wood engraving in Europe.

From this period until the middle of the fifteenth century rapid strides were made in perfecting the art and in making it available for business purposes. At first the demand was limited and confined to the religious orders. The representations of saints and other scriptural objects which the monks had for some centuries been in the habit of painting in their parchment Bibles and missals were by the early wood engravers copied in outline on wooden blocks, and divested of their brilliant colors and rich gilding, presented figures exceedingly rude in their want of proportion and not a little grotesque, from their constrained and ludicrous attitudes. But they were nevertheless highly popular, and as these crude pictures were accompanied with certain passages from scripture, they supplied the first inducement of the laity to learn to read, they being extremely ignorant at the time. There is no doubt that as crude and simple as these illustrations were, they assisted in a measure in preparing the way for that diffusion of knowledge which subsequently accompanied the invention of printing from movable types. Mankind however, are not indebted to religion, as previously remarked, for the introduction and application of wood engraving as an art, or a business vocation. Carrigi and his playing cards undoubtedly have the precedence, and called forth the art of the limner and the engraver long before religion stepped in to as a foil neutralize the bad effects they were producing upon the noble and the wealthy classes of Venice. Gambling, like many other vices and follies, is an heir loom that descends from the great to those below them in the social scale. It is easy therefore, to understand that the followers of courts and camps, as well as the artisans and dealers in the towns, seeing the amusement which their superiors derived from these bits of stout parchment, would be anxious to possess the same means of pleasurable excitement in their hours of idleness. In this way the demand for playing cards increased so rapidly that other engravers beside Carrigi entered the field, and for some time a thriving business was done in supplying not only the home demand, but for export to other countries.

Wood engravers were subsequently employed in getting up illustrations for books. The first specimen of any note of this kind is in the collection of the late Earl Spencer. It is a curious cut taken from a wooden block, representing St. Christopher carrying the infant Savior. This work bears date 1423. If not the first specimen of the art of line engraving, it is the earliest undoubted document which determines with precision the period when wood engraving was generally applied to books, and objects of a devotional character.

In a very few years after the period above named, the art of wood engraving reached a more important object: viz., that of aiding in popularizing books of instruction. Up to this time Bibles were written on parchment and could only be obtained at a fabulous cost. It was then thought that a selection of subjects from the Bible with appropriate illustrations, both engraved on wood, might be acceptable to the common people. Such a book was produced in the year 1440, and was called "Biblia Pauperum"—the Bible of the poor. This very rare book consisted of forty leaves of small folio, each of which contained a small wood cut with extracts from the scriptures and other religious authorities. This was followed by other works of a similar character, the most remarkable of which is called "Speculum Salutis"—the Mirror of Salvation. In this performance the explanation of the texts are much fuller than in the work previously named. In this work the illustrations and the texts are printed from wooden blocks. In addition to these religious works wooden blocks were also used to print small manuals of grammar, called "Donatuses," which were used in schools. From this period the art of engraving on wood gradually merged into the art of printing from movable types. The early printers, imitating the manuscript books upon papyrus and parchment, used largely wood engravings of initial letters, and at times the pages of their works were adorned with wood-cut borders and frontispiece illustrations. At this period if a figure or group of figures were introduced, little more than the mere outline was attempted.

In the "*Historiæ Veteris et Novi Testamenti*," published about this time, a number of wood-cut illustrations appeared in it, the one in the frontispiece is especially note-worthy from the fact that a better class of wood engraving, in which gradations of light and shade, and the light hatching dots subsequently used, were represented. Mr. Ottley, in his "Early History of Engraving" tells us that an engraver on wood named Wohlgemuth, who flourished in Nuremburg, in 1480, first succeeded in imitating the bold hatchings of a pen drawing, on wood. Subsequently Albert Durer, became the pupil of Wohlgemuth; and by him and later by Holbein (both artists of note) wood-engraving was carried to a perfection, which it subsequently lost until its renewal in England by Bewick. For a century and a half, however, after the above named period, wood cuts were profusely employed in the illustration of books in Italy, Holland, France, Germany and England. Two of these early works, published in England, viz., "Hollingshed's Chronicles," and "Fox's Book of Martyrs," clearly attest how instructive and amusing illustrated works were considered even at that early day.

The gradual diffusion of knowledge and the consequent increased demand for books among the nobles and wealthy classes, led to a more costly style of embellishments than the crude wood-cuts then in use. This demand of the wealthy classes led to the discovery of engraving on copper plates. Sir John Harrington's translation of "Orlando Furioso," published in 1690, was the first English work in which copper plate engravings were used. From this time until the latter part of the eighteenth century the use of wood cuts gradually declined; that is to say, that as a high branch of art, wood engraving was almost entirely lost, until the appearance of Bewick, an ingenious artisan, who prosecuted his business at Newcastle-upon-Tyne. His cuts of quadrupeds and birds are as remarkable for their force and delicacy of execution as engravings, as for the vigor and accuracy with which he drew them; and his humorous vignettes possess a truth of character which has been seldom equaled. The success of Bewick created a number of artists in wood engraving, but until the last half century the art was not applied to its legitimate purpose, which is the art of design naturally associated with cheap and rapid printing.

The wood engravers, who were contemporary with and immediately succeeded Bewick, were generally employed in the illustration of the most costly works, the introduction of the cuts often rendering the printing of the other portion of the book so expensive, that volumes thus embellished were as costly as though they had been printed from metal plates. The cause of this was simply because these engravers employed a certain method in working their blocks, requiring extraordinary care in the impressions after the engravings were executed, and the wood cuts being included in the same page and sheet with the text, even though a single wood cut appeared on a sheet, the attention it demanded from the pressman prevented the rapid working off of the other pages, thus compelling a great waste of time.

Correspondence.

The Editors are not responsible for the Opinions expressed by their Correspondents.

Expanding Steam--Test of Engines.

Messrs. Editors:—On page 197, of your current volume, I criticised the claims of certain steam engine builders by comparing their pretentions with some of the known laws of mechanics. These builders claimed, that in working steam at 60 pounds pressure in their engines, it expanded to 16 volumes, and still retained a pressure of 3 pounds, and showed diagrams of cards to prove the claim. I asserted that no such card could have been fairly taken from any engine, under the conditions claimed. From the editorial remarks upon that communication, it is evident that you understand me to have deduced those conditions from the diagram. This is not strange. But how your correspondent, on page 230, who claims to speak for those builders, and is, of course, familiar with their circular, could honestly think that the figures I gave of the amount of steam admitted to the cylinder, were obtained by estimate from the card, is a little more wonderful.

The truth is, I made no *estimate* whatever, of the amount of steam admitted, nor of the power obtained; but took both from the positive statements of the circular. It is there *stated* that "steam enters the clyinder at 60 pounds, and follows only 1½ inches, and is instantly cut off." Again, (I quote from the circular), "thus we have the area of a 12-inch cylinder, which is 113 inches by 1½—169·50 inches of steam to move the piston from one end of the cylinder to the other." And again, "steam striking the piston at 60 pounds, and falling to the 3 pounds at the end of the stroke, gives us an average pressure of 17½ pounds, the entire length of the cylinder, requiring *only* 169½ cubic inches of steam."

It was the above conditions that I asserted could never be realized by any engine.

Your Utica correspondent, forgetting these statements, very kindly informs us, that it is an error to suppose "the amount of steam used is measured by that admitted to the cylinder up to the point of cut-off," that "it is the volume of steam in the cylinder, at the opening of the exhaust valve, which determines the quantity of heat required to do the work." Could this important truth have been discovered by the parties who publish the circular in question, before analyzing their own diagram, what a difference it would have made in their figures! Their cylinder contains, at end of stroke, 2,712 cubic inches of steam, of 3 pounds pressure, by the gage. This, if admitted at 60 pounds, could not, with the smallest possible allowance for attenuation, have expanded to more than four volumes, so that, in place of using only 169½ cubic inches, as they assert, we have, by this rule, at least 678 inches.

Here is a slight difference in figures, but perhaps it may be of no consequence to your correspondent, as he proposes to disregard some other matters of importance. He says, "The item of units of heat lost in developing power may be disregarded, or rather only regarded generally along with other losses, of which the indicator takes no note, such as leakage of piston and exhaust valve, condensation, etc.".

Now, it is true that leakage of piston, and valves, and condensation, are not considered in the *theory* of expansion, but the assertion that, in *practice*, they are taken no note of by the indicator, will certainly be received with surprise. And as to the heat lost in developing power, either the theory that disregards it is false, and the indicator that fails to note it unreliable, or the whole doctrine of the correlation of forces is untrue; for, according to that doctrine, the heat lost must be the equivalent of all the power utilized by expansion.

The writer complains that "the card published in the Scientific American is not exactly a reduced copy of the one in the circular," that "the compression curve" is not made by lead of steam valve, and that the card shows a "negative steam lead," etc. It is true this card is slightly inaccurate, but is rather nearer to the *described card* in the circular, than their own diagram. As to the "compression curve" and the "negative steam lead," every engineer knows that by closing the exhaust valve early and compressing the steam remaining in the cylinder, the pressure will rise at the end of the stroke, independent of the opening of the steam port; but that this pressure will continue to rise, "the steam valve not opening until the piston has moved some little distance on its forward stroke," is a discovery for which science must be greatly indebted to your Utica correspondent.

Now, a word on the practical side of the question: Mr. J. H. Fountain, of Elmira, N. Y., has, in his flouring mills, at that place, one of those "short cut-off" engines, which was warranted by the sanguine builder to save 40 per cent of fuel over any single slide valve engine. A test was was by the builder, of a ten hours run, which was satisfactory to himself, but not to Mr. F., who has since put in a small slide valve engine. This he did for the purpose of making a careful test. Under date of April 4th, he writes me as follows: "We tested the slide valve engine last week, on a ten hours run, with the same kind of grain and fuel as with the engine that was to save 40 per cent of fuel, and the slide valve ground *more grain*, and with *less fuel* than the other, saving just twelve per cent from the amount used by the short cut-off. The small one, too, worked to great disadvantage, as it was set on light timbers, in a temporary manner *geared* to the shaft of the other, and with a long steam pipe to it. Mr.——(the builder), on making a test personally, with his engine, pronounces it as good a result as he ever knew, yet it is badly beaten by this country made engine." . . . Mr. F. also says, that the short cut-off gives an irregular motion, jamming the machinery, loosening the irons in the stones, the toes of the spindles, etc., which might be expected as a natural result, where the initiatory pressure is high and the final pressure a partial vacuum.

Keokuk, Iowa. E. S. Wicklin.