An account of a new explosive engine, generating a power that may be substituted for that of the steam engine. By SAMUEL MOREY, of Oxford, New Hampshire.

TO PROFESSOR SILLIMAN.

Dear Sir,—Having accidentally discovered that the vapour of water and that of spirit of turpentine, when mixed with a very great proportion of atmospheric air, were highly explosive—I have been endeavouring to produce therefrom, a useful mechanical power; and embrace the earliest convenient opportunity to send you an account, and the result of some experiments. I should hope they may, at least in part, find a place in your Journal.

Alcohol may be substituted for water, or added to it in any proportion. The vapour, and atmospheric air, if placed in contact, will in time unite, as hydrogen gas and common air do, and become apparently as highly explosive. But the process by natural evaporation, would be too slow, when the use or demand was very considerable, unless the reservoir was very large, when it would then be inconvenient, expensive and unsafe. It was desirable to prepare or manufacture the article as wanted. In time it was effected. It was also very desirable, (and there was not, to me, any apparent reason why it might not be effected,) to command or control the explosions, as we do those of gunpowder, although they are much more violent. Another most desirable object, was, to unite in the same engine, if it possibly could be done, the effect or force of the explosion, with that of the vacuum, which always accompanies it; and that, without rendering it too complicated, expensive, and unsafe. By pursuing a course very analogous to that adopted for the use of gunpowder, it was in a measure, if not entirely, effected.

The preparing part of the machine consists of a metallic vessel, or tube, so constructed, that a stream or current of atmospheric air, may pass freely through it, together with the vapour or gas to be made use of; both being impelled through a space interrupted by short turns, or other impediments; the object of which is, to blend, mix, or unite them intimately with each other, by which process they are rendered highly explosive. This apparatus admits of an endless variety of forms. A description of one follows, which is found to be perfectly safe, and probably as convenient as any. Make a box of tin plates, four or five inches wide, and about fourteen long, and seven deep. Divide it horizontally, into four or five compartments, by partitions, which extend from one end of the box, to within a short distance of the other end, so that the air, entering the lower part, will be compelled, by the partitions, to travel the whole length of the box, through each compartment, in its ascent to the top;—divide these compartments, by vertical partitions, running the whole length of the box, except at the beginning, or where the air enters and passes out, into spaces, about half an inch apart, which have the double advantage, of effecting by their friction, a rapid mixture of the air and vapour with each other, and also of preventing violence in the explosion, should one take place in the box. A short tube for the admission of air and

other materials into the lower apartment, and another for letting out the explosive, or prepared air from the upper one, each covered with fine wire gauze, to prevent explosion, will complete the preparing vessel. The opening to this box should be about two inches in diameter.

The exploding part of the machine, also admits of a great variety of construction. The following may serve as a convenient one. Have a cylinder fitted with a piston or plunger, and connected with a crank shaft, as in the steam engine, let the lower end of the cylinder have a valve of at least half its diameter, opening outwards. This valve may be made of thin soft leather, of the same diameter as the cylinder. This leather is to be tied or fastened to the lower end of the working cylinder, so as to form a continuation of the same. The lower end of the leather cylinder or valve, is to be flattened, so as to bring its inner sides together, for about four or five inches of its length, and kept in that position, by light springs attached to the two edges of the flat part, placing it in a position much like that of a bow, and bow-string. This valve is supported, or prevented from being driven into the cylinder, by a plate of metal, of sufficient thickness to bear the pressure of the atmosphere, arched or raised outwards, and perforated with as many holes as can be well made in it; the holes should be from about $\frac{1}{8}$ to $\frac{1}{4}$ an inch in diameter. The end of the cylinder forms the abutment to this arched plate. An air valve, also opening outward, is fixed in the side of the cylinder, just below the piston when down. A pipe from the preparing vessel, is inserted, or attached to the side of the cylinder, at from $\frac{1}{8}$ to $\frac{1}{4}$ of the length of the stroke from the top. This pipe should be as short as it can conveniently be, and it should be furnished with a valve next the preparing box, to cut off the communication with it, and a small valve about half an inch in diameter, next the cylinder, to let the inflammable air communicate with the flame of a lamp, so as to take fire, and communicate, by the trail, to the charge in the cylinder. These valves also open upwards, but as the explosion meets with so little resistance below, they are never thrown upwards. They, as is also the air valve, are worked by beams on the crank shaft, or by any other convenient mode. To give a double stroke, it will require two cylinders fitted up in this way, communicating with the same preparing vessel and crank shaft. When vapour is intended to be used, put a little alcohol, or high proof spirit, either alone, or with the addition of a small portion of spirit of turpentine, or put in spirit of turpentine and water, or other convenient materials, capable of evaporation, and the vapour of which is inflammable, when mixed with atmospheric air, into the lower apartment of the preparing vessel; the proportion of each is not very material. Apply a small lamp, or other heating substance, to raise the temperature to about blood heat, and place the flame of a lamp, at the inflaming valve. The piston being down, in its ascent would form a vacuum under it; this is prevented by opening the air valve which supplies the cylinder with common air, until the piston reaches the pipe from the preparing vessel. It then closes, and the vapour valve supplies the remainder of the cylinder, through the preparing vessel, with the explosive air, and just

before the piston is up, say about $\frac{1}{4}$ of an inch, the vapour valve closes at the same time that the inflaming valve opens and shuts, the piston being then still rising, draws or turns the flame of the lamp at the firing valve, through the opening into the pipe, inflames the trail, and it is instantly communicated to the charge in the cylinder; the explosion that ensues, drives out the air from within the cylinder, through the perforated arched plate and leather valve at bottom, which valve instantly collapses and prevents the return of the air. The steam, formed by the explosion and formation of the vacuum, is condensed, by keeping the lower part of the cylinder cool, by surrounding it with water, and suffering the vacuum to inject a small stream of cold water near the bottom—which also keeps the arched plate, and leather valve, cool. A vacuum under the piston, instantly follows the explosion, which descends by the pressure of the atmosphere, and carries the crank with it, while the same process is repeated in the second cylinder, and the power is taken from the crank-shaft, or piston-rod, as in the steam-engine. When the temperature is low, smaller charges will produce the same effect, if a thin metallic plate of the same diameter as the piston, be introduced into the cylinder, called the charging piston. It is fitted with a small rod, which moves through a stuffing-box in the main piston, so tight, that the friction will support its weight. This charging-piston is prevented from rising higher than the vapour-pipe, by its end striking against a stationary point, in its ascent, and forming a partition between the compound air in the cylinder, and the common atmospheric air, thereby preventing so great a mixture of atmospheric air in the cylinder, as to lessen the effect of the explosion.

When the temperature of the box is so high as to give off too great a proportion of vapour, the engine works better, by stopping entirely the working of the charging piston, but not with so good economy. This charging piston should be fully perforated with small holes, lest by accident it should not rise with the working piston, as well as to let the explosion pass freely through it, to clear the cylinder. Wire gauze should also be placed between the vapour and inflaming valve, to prevent explosion in the box, should the vapour valve not close in time. When hydrogen gas is intended to be used, an apparatus similar to Professor Hare's compound blow-pipe, may be attached to the engine, to throw the air and gas into the preparing box.

A box of the form and size before mentioned, appears to be sufficient to prepare air fast enough, with a small lamp, to furnish from fifty to one hundred charges per minute, for a cylinder of seven or eight inches in diameter, having a two foot stroke, the box being in use only one quarter part of the time; it, of course, would supply four such cylinders if the air was constantly blown or drawn through it. To keep up the temperature of the box, would, in that case, probably require more heat, but it does appear, that the more rapidly the air is made to pass over the liquors, the more rapidly it takes up vapour at the same temperature.

The following, are some of the methods, I have successfully adopted, in producing a power from this same source.

I have caused the air, by the effect of the explosion, to be compressed over a column of water, to such a degree, as to throw it to a great height and distance.

I have, in a measure, reversed it, and by forming a vacuum in a vessel above, the water would be driven up, by the pressure of the atmosphere.

I have caused the explosion to compress, in a reservoir, a quantity of atmospheric air, and made use of that compressed air, for working an engine, similar to a double stroke high pressure steam engine.

This mode will make it perfectly safe on account of fire, as the compressed air may be led, in tubes, any distance, before it works the engine.

Sometimes I have made a valve in the piston to open upwards, and fill the cylinder below the piston with the prepared air, and when the piston is about half way up the cylinder, it is at the height of its working stroke; the explosion then takes place. The effect is, that the quantity of air above the piston is nearly doubled; its elasticity or force is also greatly increased, by a great increase of its temperature, it now re-acts on the piston, while a vacuum below, adds greatly to the effect. This mode acts with great energy in a small space.

I have attached to the working piston, thin tubes, about $\frac{3}{8}$ of an inch in diameter, open at top, each one of which is directly over and enters one of the tubes of a condenser, attached to the bottom of the cylinder, which tubes are $\frac{1}{4}$ of an inch in diameter. The prepared air, as usual, is let into the cylinder near the upper end; as the piston rises, it fills with the prepared air, the upper part of the tubes, and the spaces around them, and when the piston is nearly up, the explosion takes effect, but the tubes prevent all violence.

At, or near all of those springs, which are constantly giving off hydrogen gas, engines may be erected (substituting the gas for that of the vapour of the liquors) to work constantly, for every desired mechanical purpose. The engines can be placed in any chosen situation, by only conducting the gas through tubes, and if desired, the air and gas may pass in due proportion through the tubes together, which, with a few short turns, will insure its suitable preparation, although the distance should be short.

The explosive vapour engines will work without any fire, when the temperature of the weather, in the sun or in the shade, is about 80 or 90°, provided the charge be inflamed by the electric spark. With a due proportion of ether, according to the temperature of the weather, it is probable that the engine will work at any time, with only a lamp to inflame the charge.

The less is the proportion of alcohol the higher temperature will be required. So again, the more turns, back and forth, the air makes in contact with the liquor, in the box, the lower temperature will be required to prepare it. If the temperature of the box gets down to about 70°, the spirit of turpentine refuses to come over at all, or at least, in sufficient quantity to give energy to the explosion. I have lately substituted a plunger, in lieu of the piston, and attach the stuffing to the top of the cylinder; it works well, and is more conve-

nient. A small bellows is convenient in putting the engine in motion, or the explosive air may be blown into the cylinder, and inflamed, to warm it, and commence the operation.

A very easy mode, to try an experiment, for the purpose of preparing this explosive air mechanically, is to have made a few feet of inch tubes, of common tin plate. These tubes should be turned, once in about a foot, at right angles, and the long part should be filled with small tubes, about $\frac{1}{4}$ of an inch in diameter. If air is made to pass through this crooked tube, while it contains a single spoonful of high proof whiskey, and spirit of turpentine, with a proper temperature, it comes out highly explosive, if the current is forced through by a hand bellows, with ever so much velocity. As we now construct the engine and preparing vessel, it is impossible that an explosion can take place, that will injure any one. A few drops of these liquors, on a board in the sun, with a tumbler inverted over them, will explode in a short time, if a flame is applied.

It will not, I trust, appear surprising, that these improvements are patented.

I am, dear Sir, yours, most respectfully,

SAMUEL MOREY.

P. S.—I am sensible, that a drawing ought to accompany this paper, but at present, it is out of my power to furnish one.

[*Silliman's Journal.*]

A method of Preserving Lime-Juice. By Captain T. M. BAGNOLD.

From the Transactions of the Society for the encouragement of Arts, Manufactures and Commerce.

It is well known that the Juice of lemons, or of limes, expressed from the fruit, will in a short time, especially if kept warm, become mouldy, and unfit for use as an article of food; and that the final result of this spontaneous change is the destruction of the acid itself. The acid may, indeed, be separated from the other matters with which it is naturally mixed; but in so doing all the odour and flavour of the native juice are also destroyed, for pure crystallized citric acid is wholly inodorous, and to the taste simply acid.

The effect of pure citric acid, in preventing or mitigating the severity of sea-scurvy, is greatly inferior to the recent juice; and in many of our circumnavigations, lemon or lime-juice, mixed with a small proportion of rum, about one-tenth, has been found to keep for a considerable time in tropical countries, and to be very efficacious in preserving the health of the crews. In some cases, however, this addition of spirit is by no means desirable.

In April, 1824, Captain Bagnold produced to the committee a specimen of lime-juice, which had been prepared in Jamaica in the preceding September, according to his directions. The juice having been expressed from the fruit, was strained, and put into quart bottles: these having been carefully corked, were put into a pan of cold