combination of alimentary principles for the daily support of an ordinary working man of average hight and weight. It is as follows:

Albuminous matter............	4·587 ozs.
Fatty matter..................	2·964 "
Carbo-hydrate.................	14·250 "
Salts..........................	1·058 "
Total	22·859 ozs.

Thus about 23 ounces of dry solid matter, one fifth nitrogenous, may be taken as sufficient for the daily needs of an average adult workman. Ordinary food contains about 50 per cent of water, which would swell this amount of dry matter to 46 ounces of solid food. To complete the diet, we must allow from fifty to eighty ounces of water in addition, daily.

Of course, the varying requirements of youth and age, hot weather and cold, indoor and outdoor occupation, individual idiosyncracy, taste, and a thousand other conditions combine to vary the proportion of the several elements needed in any case; nevertheless, all such average determinations are helps toward the developed science of dietetics, which the coming years will see.

DEMONIACAL POSSESSIONS.

The devil dies hard, and the fifteenth century lingers in other quarters than Italy and Spain.

In the middle ages the unfortunate victim of morbid or insane impulses was looked upon as the sport of demons. The history of medicine records the successive steps of progress in knowledge by which this delusion was dispelled, and the true cause of these maladies was found to be organic derangement or vicious education.

A man of kindly disposition suddenly manifests an irresistible desire to kill somebody. He may say that his grandmother's ghost or the spirit of George Washington has ordered him to shed blood; but intelligent people know better. They do not assume, as of old, that some evil spirit has caught his soul abroad and has slipped in and taken possession of the vacant body for diabolical purposes. They say that something is wrong in his physical organization, a tumor on the brain, may be, and treat him accordingly. When he dies, the surgeon's knife will lay bare the cause of the difficulty, which had been slowly developing, perhaps for years before the crisis came. Does any one wonder why, at this late day, we soberly set down what every civilized child is supposed to know? or soberly discuss a theory that died with witchcraft? Simply to spring upon the intelligent reader the surprising fact that belief in witchcraft and the theory of demoniacal possessions is not dead, here, in this land of common schools and newspapers: not among the illiterate, but among newspaper readers: worse, among the editors of newspapers which profess to lead the advance of civilization.

How does this sound for the nineteenth century? We quote from a family paper bearing date October 8, 1874:

"A favorite scoff against religion has been founded on the instances, recorded in the gospels, of persons who were possessed with demons. Perhaps two items of news published recently may throw some light on the demoniacal possessions on which infidels have long exercised their wits." The paper goes on to describe the case of the Pomeroy boy of Boston, and that of a girl in this city who felt a strong desire to burn an infant she was nursing, but fortunately confessed the desire before attempting its execution; then it continues: "These are two of the latest startling items of news. Do they not look as if the devil had more power over human nature than he is ordinarily credited with? In view of them, can we say that demoniacal possessions are impossible?" This is from the *Christian Observer*, and is quoted approvingly by another *Observer*, which puts *New York* as part of its title, but is presumed to be Christian all the same.

We do not know the circumstances of the last mentioned case, nor the history of the girl whose homicidal desire was kept from being carried out. Cases of the kind, however, are not uncommon, and not unaccountable, without the devil's assistance. As regards the Pomeroy boy, there was never a clearer case of moral warping by vicious influences, systematically brought to bear on the child *in utero* as well as in infancy. Had the mother's desire been to breed a monster of bloodthirstiness, her course could not have been more surely adapted to accomplish that end. And the mother's morbid pleasure at the sight of blood was not only inherited but cultivated by the child, who was a butcher by instinct, taking up his father's trade almost as soon as he could walk. Yet we are gravely told that this boy's horrid desire to see how a child would die was due to his momentary possession by the devil!

This is worse than the experience of a medical friend, who, calling the other day to learn the effect of a prescription for a sick child, was greeted by the mother with the triumphant exclamation. "I don't think baby will have convulsions any more!" "Ah!" said the doctor; "why not?" "*I've burned his shirt!*" The lady is the wife of a wealthy merchant and a member of polite society. Very likely she reads the *Observer*: possibly both of the papers of that name.

REPORTS ON SMALL ENGINES.

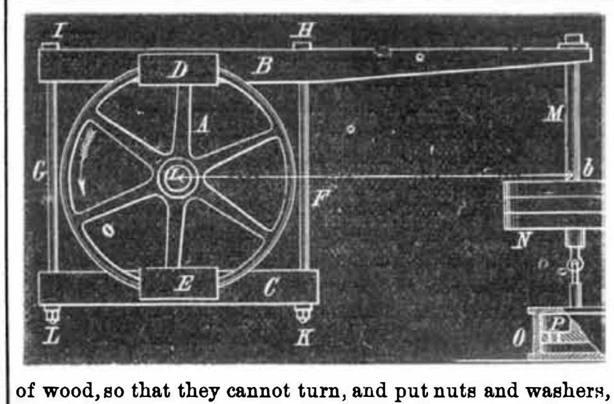
We have been much gratified, of late, by the receipt of letters giving particulars of small engines and boilers. Data of this kind are extremely valuable, showing the results of actual practice, and we hope to receive many more letters of the same kind. These accounts would be more interesting and useful, however, if they contained fuller details of the performance; and we propose to give some account of the manner of making a test. The apparatus needed is quite simple, and can be readily constructed by the young mechanic. The following embrace the principal points that are generally of interest in regard to engines and boilers: Diameter of cylinder, length of stroke, diameters of piston rod, connecting rod, crank pin, valve stem, fly wheel, and shaft; lengths of connecting rod and crank pin, weights of whole engine and of fly wheel, size of ports, stroke of valve, point at which steam is cut off, number of revolutions per minute, clearance at each end of cylinder, pressure of steam in boiler, dimensions and weight of boiler, diameters of steam pipe and safety valve, number of pounds of water evaporated, fuel burned per hour, and power of the engine. Many of these data are obtained at once, by direct measurement or weight. The diameter of the cylinder should be measured when it is at the temperature at which it is ordinarily maintained while running. The point of cut off can generally be ascertained by removing the cover of the valve chest, and observing the point at which the steam valve closes when the engine is moved by hand. This should be done when the parts are heated. The clearance at each end of the cylinder includes not only the space between the piston and cylinder head at the end of the stroke, but also the volume of the ports. A simple and accurate manner of measuring the clearance is to fill the cylinder with water, when the piston is at one end of the stroke, and then measure the water carefully in a cylindrical or rectangular vessel. The difference between the volume of the water and the volume of piston displacement (area of piston multiplied by length of stroke) will be the clearance. In measuring the piston displacement at the front end of the cylinder, the volume of the piston rod (area of section of rod multiplied by length of stroke) must, of course, be deducted.

The number of revolutions of the engine per minute can be determined approximately by observation; but errors are apt to result, especially in the case of small engines moving at a high rate of speed. Small shaft counters can be obtained at a very reasonable price, and measurements made with them are far more likely to be accurate.

Many small boilers are not provided with steam gages, so that the pressure of the steam cannot be observed directly; but all such boilers have, or should have, safety valves, and the pressure of the steam can be determined from them. Secure the valve stem of the safety valve to the lever, with wire or string, and attach a loop to the lever, into which pass the hook of an accurate spring balance, arranging the loop so that it is directly over the center of the valve stem. Then take hold of the upper part of the spring balance, and lift the valve slightly, noting the reading of the balance. Measure the lower diameter of the safety valve, and find its area; divide the reading of the spring balance by the area of the valve, and the result will be the pressure, in pounds per square inch, at which the steam will raise the safety valve. Suppose, for instance, that the diameter of the safety valve is 1 inch; its area will be about $\frac{7854}{10000}$ of an inch. Now, if the tension of the spring balance in raising the valve is 120 pounds, the pressure at which the valve will rise is the quotient arising from dividing 120 by $\frac{7854}{10000}$, or 153 pounds per square inch. It will be easy to make a table for any particular case, giving the pressure corresponding to each pound or fraction of a pound of tension in the balance; and by calculating in advance the reading of the balance for any given pressure, the weight can be adjusted on the lever until that tension is obtained, and the valve can thus be graduated to lift at any required pressure. It may be added that this simple method is applicable to any safety valve, and affords a ready means of testing the accuracy of the graduation; but at present we are treating of this method only with a view to explain how the steam pressure in the boiler may be ascertained at any time. Having determined the pressure at which the safety valve will rise when the boiler is cold, raise the valve by means of the balance, from time to time, when the engine is working, and observe the tension. Find the pressure corresponding to this tension, and subtract it from the pressure at which the valve will be raised by the steam. The difference is the pressure in the boiler at the time. For example, suppose that in the last case the tension of the balance, on raising the valve when the engine was working, was 50 pounds. The pressure corresponding to this will be 50 divided by $\frac{7854}{10000}$, or about 64 pounds, so that the pressure in the boiler at the time would be the difference between 153 and 64, or 89 pounds per square inch. By preparing a table showing the pressure in the boiler due to each pound of tension in the spring balance, the pressure at any time can be read off as soon as the indication of the balance is observed.

The amount of water evaporated per hour and the fuel burned can, of course, be readily determined by measurement, drawing the water from a tank of known dimensions, and observing its state at the commencement and close of a trial, being careful to leave the water in the boiler at the same hight at which it was at the commencement, and maintaining this hight as constant as possible during the experiment. In measuring the fuel consumed, it is best to draw out the fire at the commencement of the trial, rekindling it as soon as possible, and charging all the fuel used from that time, hauling and quenching the fire immediately at the close of the trial, and weighing back all fuel that is unconsumed. In the case of small boilers heated by lamps, a measurement of the oil used between the beginning and end of the trial will generally be sufficient; and if gas is employed as fuel, it will be necessary to attach a meter to the pipe, to determine the quantity consumed in any given time.

To ascertain the power of the engine, the most convenient method is, generally, to attach a friction brake, shown in the accompanying engraving, to the band wheel. Hollow out two pieces of wood, B and C, so that they will fit the circumference of the band wheel, A, and attach light plates of metal, D and E, to the sides, so that the pieces of wood cannot slip off when secured in position. Provide two belts, F, G, countersinking the heads, H and I, into the upper piece



of wood, so that they cannot turn, and put nuts and washers, K and L, on the other ends, so that the two pieces of wood can be clamped on the band wheel as tightly as is necessary. Make the upper piece of wood somewhat longer than the other, and pass a rod, M, through the end. On this rod weights, N, are to be placed, and the lower end of the rod is hooked to the piston rod of a small cylinder, O. The piston, P, fits loosely in this cylinder, which is filled with oil or water; and the piston has small holes in it, so that it can move up and down without much resistance, if moved slowly, but offers considerable resistance to sudden motion. The action of the apparatus will doubtless be apparent to our readers. By tightening the nuts on the bolts, F, G, there will be considerable friction between the band wheel and the pieces of wood. The rod, M, must then be loaded with sufficient weight, so that the engine can just move at its regular rate of speed, and keep the upper piece of wood in a horizontal position. The friction on the band wheel will cause it to become heated, unless some arrangements are made for cooling, either by keeping a stream of water running upon it, or immersing the lower part in a trough in which the water is constantly changed. The small cylinder, O, and piston, P, serve to counteract the effect of sudden shocks, which would otherwise throw the arm of the piece, B, from a horizontal position. Now it will be plain that, as the band wheel revolves (constantly maintaining the arm, with the weight attached, in a horizontal position), the effect is the same as if it were lifting this weight by means of a rope running over a windlass, and the distance through which it would lift the weight in a given time is the same as the weight would move if the whole apparatus were free to revolve. If, for example, the wheel makes 300 revolutions in a minute, the distance from the center of the wheel to the center of the weight is 1 foot, and the weight is 10 pounds; this weight, if free to revolve, would move in each revolution through the circumference of a circle whose radius is 1 foot, and in a minute would move 300 times as far, or about 1,885 feet. The work of the engine in a minute, then, will be that required to lift 10 pounds through a hight of 1,885 feet, or 18,850 foot pounds; and as one horse power is the work represented by 33,000 foot pounds per minute, the engine would be developing a little more than half a horse power.

In making experiments with the friction brake, the apparatus should be placed loosely on the band wheel; and before the weights are attached, a spring balance should be secured to the arm, at the center of the hole for the rod, M, and the reading noted when the arm is in a horizontal position. This reading must be added to the weights that are afterwards attached. The horizontal distance from the center of the wheel to the center of the rod, M, should be carefully measured. Then start the engine, with the throttle valve wide open, and screw up the nuts, K, L, gradually, adding weights at N. It will then only be necessary, when sufficient weights are added, to keep the wheel cool, and occasionally adjust the nuts, K, L, should the brake bind or become too loose from any cause. Should it be difficult or inconvenient to maintain the arm in a horizontal position, note carefully the position it assumes during the test; and for the radius to be used in the calculation, measure the distance, *a b*, from the center of the wheel to the center of the rod, M, in a direction perpendicular to the direction of the rod.

Instead of the weights, N, and cylinder, O, a spring balance may be attached to the end of the rod, M, and secured to some fixed support, its readings during the trial being used in place of the attached weights. In this case, also, the weight of the apparatus must be first determined, and added to the readings of the spring balance. The plan represented in the engraving is, however, the best.

We have thus described, in detail, the methods to be pursued in preparing a report of the performance of small engines and boilers. Although they are far from fulfilling all the requirements of a scientific test, they will give very accurate results if carefully conducted. Should any of our readers make the experiments referred to in this paper, we shall be glad to receive the results, with full particulars.

THE PHYLLOXERA.—R. J. writes to assure us that 1 pint slaked lime, mixed with half a peck horse manure, put round the roots of each vine, will ensure a speedy cure for the disease, protect the plant from frost, and give it a vigorous growth. This remedy, which has been tried and found successful, should be applied in the fall of the year. He offers us half the reward.