THE GAMGEE PERPETUAL MOTION.

One of our reporters called upon Mr. Edward N. Dickerson, the civil engineer and lawyer, to get his views with regard to the Gamgee "thermo-dynamic engine" and Chief Engineer Isherwood's report thereon. After reading the extract from Isherwood's report, as published in this paper last week, and after examining a copy of Gamgee's letters patent, Mr. Dickerson said that his attention had not been called to the matter before, and that he was somewhat astonished that Isherwood, who had published two or three books in years gone by, and expended millions of the public money in the attempt to prove that there was no power to be got out of expanding steam, should now be found advocating an engine whose entire merit is supposed to consist in the power that will result from the expanding of another liquid following the same laws as water in its operation; and that, in his opinion, the ignorance exhibited in the first publications is equaled by that exhibited in the last. In the first publications he denied the value of the dynamic effect due to expansion, and in the second one he converts that effect into the means of producing perpetual motion!

Mr. Dickerson then went on to say: The truth is, that any gas whatever which is produced by vaporizing a liquid will give out more or less of the value of the heat expended in the production of it, as it is expanded more or less. Isherwood, in the position of Chief Engineer of the Navy, prevented this simple truth from being made available for the United States for many years; and now he is going to the other extreme in assuming that if some other liquid beside water be used, not only an enormous amount of power can be obtained, sufficient to drive navy vessels without fuel, but that this enormous power, produced by means of expansion, has the faculty of restoring the liquid used to its normal condition by its own internal action, when it will be ready to perform the ceremony over again *ad infinitum.*

A simple way to illustrate this whole subject is to suppose a thoroughly exhausted vessel of any kind, into which some liquid ammonia or other low-boiling substance is introduced. If that liquid can derive from the environment heat enough to vaporize it, it will be thoroughly evaporated, and will fill that vessel under a tension corresponding to its volume and heat. When that is done the work of that amount of heat thus absorbed has been accomplished, and the gas will be very cold, if the volume into which it expands bears a large proportion to its normal liquid volume. Now if in that condition, and by reason of this low temperature, this gas could suddenly reconvert itself into a liquid form, it could be very readily replaced in the original vessel, or a similar one, and again derive its heat from the environment and reproduce the original effect. The difficulty about it is that it will not reconvert itself into a liquid, and this is the fallacy of the whole assumption; and in order to reconvert it into a liquid form it must be compressed into its liquid dimensions, when it will again be as warm as it was in the beginning, and when the power expended in reproducing it will be equivalent to that it gave out in the expansion. This general truth may be confused by pictures of cylinders, condensers, and by jargon; but it is altogether probable that this law will assert itself notwithstanding the confusion that will result from such an organization as Mr. Gamgee exhibits in his patent. If not, there is, practically, a perpetual motion machine made.

In all engines operated by heat, whether atmosphere, steam, or the vapors of other liquids are used, a constant condition of disturbed equilibrium must be maintained between the opposite sides of the piston or diaphragm which is to exhibit the motion. One side of it may be made hotter than the ordinary temperature, while the other side need then only be of that temperature, or the ordinary temperature may exist on the one side and the opposite side may be made colder; and whenever that disturbance does occur a tendency of the gas to pass from the hotter to the colder space will exist, and power can be got. But, in order to make an engine operative, that tendency must be made chronic, or in other words, artificial heat must be added at one end, or the natural heat which has been expended at one end must be destroyed at the other by some refrigerating process. I have often said that if I were lecturing in a scientific school I would have a steam engine running in which the boiler should be filled with a mass of ice; and such an engine, which might easily be made, would illustrate the whole subject in a very striking way. Steam at the freezing point has a pressure of about one-tenth of a pound to a square inch; and, of course, if a pressure of about one hundredth of a pound to a square inch could be produced on the opposite side of a piston, ice steam would drive the engine; but it would require artificial refrigeration, and, of course, an expenditure of power at the lower side much more costly than to put an alcohol lamp under the little boiler at the upper side. It never occurred to me, however, that my ice machine would, by the expansion of this ice steam, destroy the heat and restore the ice to its normal condition in the boiler, so as to run in what Gamgee calls a closed circuit.

The best steam engine now existing (which consumes two pounds of coal an hour a horse power) yields about one tenth of the power which the combustion of the coal would theoretically produce, measured by thermal units. This result is more than twice as great as in Isherwood's engines built upon the theory that there was no benefit in expansion. They required about five pounds of coal an hour a horse power, or more. By carrying expansion further an engine can be easily built that will make a horse power with one pound of coal an hour, or half the fuel now used; and it is undoubtedly true that after steam has been used to its greatest capacity, the remaining heat, which now is discharged overboard in the warm water of condensation, can be utilized in vaporizing low-boiling liquids, such as ammonia, out of which a very considerable further amount of power can be obtained. But it is not worth while to make those attempts until the power to be got from steam has come somewhere near to the practical limits to which it may be carried. At present it is not half way there. When that has been done, and when all the heat possible has been used in vaporizing low-boiling liquids, there is no present prospect that more than a hundred per cent of the power of combustion will be utilized; or, in other words, it is not probable that more heat units will be exhibited in the dynamic effect than are due to the perfect oxidation of the carbon or hydrocarbon of the fuel. In all cases, practically, the limit of fall of temperature must be the temperature of the thermal ocean in which we operate, which is a variable one, affected by geographical position and seasons of the year. When the sea water is 70° hot, there never will be a time in which power can be obtained upon the assumption that a greater degree of refrigeration than 7° is possible without expense; and it will always be cheaper to raise the temperature at the other end by fuel than to lower it at the minus end by artificial means.

There is only one other set of experiments that I know of analogous to these, and they are to be found in Isherwood's "Experimental Researches in Steam Engineering," between pages 2 and 55, in which he was trying to find out a method by which steam, after leaving the boiler, could superheat itself, and in which he concluded that, although it did not do so in the particular set of trials he made, yet, if the machinery had been bigger, he thought it would! The converse of the proposition is now involved, in which the analogue of steam is *cooling itself*, and in which it would require probably a larger machine than they will be likely to make in the Navy Yard to establish a successful result!

INSECTIVOROUS PLANTS.

In your issue for May 14, 1881, reference is made to the later experiments of Sig. Vayreda with some of the different species of *Silene* (catch-fly), in which he arrives at the conclusion that the plants do not digest the insects, or if they do, they are not benefited thereby any more than if they did not eat them.

During the summer of 1878, assisted by Mr. Wm. I. Tait, of Jersey City Heights, N. J., we made most careful and exhaustive experiments with the Carolina fly-trap (*Dionea muscicipula*), and arrived at exactly the same conclusion as Sig. Vayreda has done, that the so-called "feeding" of the plants in no way conduced to their health or vigor, being identical in all respects with those that had not been given the insects. One hundred healthy plants were used in each of the two experiments. The whole details of the experiment were given in the *Gardeners' Monthly*, of Philadelphia, in December, 1878, and brought out a very interesting discussion from those believing in the Darwinian theory and those who did not.

But why because the exudations from a plant are such as to cause an insect to adhere to it, or its mechanical formation entrap the insect, we should jump to the conclusion that it should then feed on its prey, it is hard to imagine.

On the "cruel plant" (*Physianthus albens*) hundreds of moths, butterflies, and other insects may be seen any day in August when the plant is in bloom—dead and dying, firmly held by their antennæ. Professor Geo. Thurber thus describes the trap contrivance by which the insect is caught: "The anthers are so placed that their spreading cells form a series of notches in their ring around the pistil. The insect in putting its proboscis down for the honey must pass it into one of these notches, and in attempting to withdraw it the end is sure to get caught in a notch, boot-jack fashion, as it were, and the more the insect pulls the more its trunk is caught." Thus caught, the insect starves to death, hence the well deserved name of "cruel plant." Now, here is a trap nearly as wonderful as that of the Carolina fly-trap, and far more so than that of the viscid exudations of the *Silene;* yet even Mr. Darwin would hardly say that the "cruel plant" feeds on these insects, any more than that the gnats caught by millions by the resinous exudations of the hemlock tend to augment their growth, or that the thistle or burdock of the wayside owe any part of their health and vigor to the scores of butterflies, moths, or bumble bees that are in their headlong flight impaled on their spines.

PETER HENDERSON.

Jersey City Heights, N. J., May 9, 1881.

SILK ADULTERATIONS.

[A simple test, showing quality and value of all silks.—Cracking, greasy, and dull wearing silks easily detected.]

Having proved by numerous experiments that all pure silk burned in a gas flame yields in ashes two-fifths of the original weight, and that all weighted silks, when burned in a gas flame, weigh less than two-fifths in proportion as they are weighted, and where there is much iron, "the chief adulterant," the color of the ash is a red brown. From pure silk the ash is always black, and the silk while burning seems to melt and run together, while the weighted silk keeps its form, shrinking equally from all parts. It is not necessary to burn any pure silk "unless comparisons are desirable," if you take the fact as established that the resulting ash is two-fifths of the original weight, and all silk not coming up to that standard is proportionately weighted.

The theory is: pure silk leaves a residue of two-fifths when burned to ash, and the weighted leaving very little ash from anything but the silk it contains, the adulterants being principally converted into vapor and gas, pass off, leaving no perceptible weight of residue.

The best method of burning the silk for testing is to lay it on a piece of wire gauze and let the gas flame pass through.

SCALE.

20	parts	silk	yielding	8	in	ashes	is	pure	silk.
20	"	"	"	7	"	"	"	⅞	"
20	"	"	"	6	"	"	"	¾	"
20	"	"	"	5	"	"	"	⅝	"
20	"	"	"	4	"	"	"	½	"
20	"	"	"	3	"	"	"	⅜	"
20	"	"	"	2	"	"	"	¼	"
20	"	"	"	1	"	"	"	⅛	"

A very good idea of the purity of silk is shown by comparison: taking a piece of ribbon—any pure color, white, blue, pink, gold, or any bright color—"one inch or two is sufficient," weigh carefully; then weigh exactly the same weight of silk to be tested, and as much as it falls short in measurement with the pure silk it is weighted. Endeavor when testing as above to get a piece of ribbon the same substance as that to be tested.

When it is considered that the weighting is a very expensive process, and that the additional weight does not in proportion add to the bulk, and that the strength, durability, softness, and luster are greatly impaired, 'tis strange that the fraud is persisted in; but it being so, and the consumer must necessarily pay the expense of the adulteration, it is for them to understand how to protect themselves.

There are many black silks that are valued by weight, manufacturers and dealers agreeing as to the dyed weight; such is what is termed French twist, often returned by the dyer three pounds for one. This silk twist is made from waste, and as it is cut up and carded there is a great amount of fine fiber on the surface, causing a dull and woolly appearance. In the process of dyeing the silk is rotted by the many baths of nitrate of iron and other chemicals; the fiber on the surface becoming very tender is beaten off, leaving a smooth hard twisted thread; but the processes are so detrimental to the strength, its use is confined to cutting up into fringes, but it soon shows its components, in becoming dull and cottony.

This French twist costs in the gray about four dollars per pound, and the dyeing heavy weight two dollars and fifty cents, so when finished there is returned three pounds for six dollars and fifty cents, or two dollars and sixteen and three-quarter cents per pound. If dyed in the regular way, sixteen ounces would return twenty and cost fifty cents for dyeing. So in that way the good silk would cost four dollars and fifty cents for twenty ounces, or three dollars and sixty cents for one pound, against two dollars and sixteen and three quarter cents for the heavy weighted. Let it be understood that the same number of yards and the same amount of good silk is in twenty ounces, costing four dollars and fifty cents, as in the forty-eight ounces heavy weighted, costing six dollars and fifty cents, and that the four fifty silk is clean and strong, while the six fifty is dirty and rotten. So the advantage is hard to be understood, and perhaps is only in the fact there are yet very many who can only understand a pound is a pound and a yard is a yard and silk is silk.

It is, however, gratifying to know many of our manufacturers depend on excellence. This, when understood by the consumer, will be found to mean the best economy.

New Haven, Ct. LEWIS LEIGH.

City Area and Sewerage.

Cities, Dec. 31, 1880.	Area in acres.	Population by census of 1880.	Density of population per acre.	Linear feet of sewers per head of population.
New York	26,401	1,206,577	45·70	1·69
Philadelphia	82.803	846,980	10·23	1·25
Brooklyn	13.338	566,689	42·49	2·81
Chicago	22.797	503,501	22 00	3·54
Boston	4,416	362,535	82 00	2·91
St. Louis	40 000	350,522	8·76	3·04
Cincinnati	15,360	255,707	16 64	0·98
San Francisco	26,880	233,965	8·70	2·82

Prints on Linen.

Copies of drawings or designs in black and white may be produced upon paper and linen by giving the surface of the latter two coatings of:

Gum arabic	7 to 10 grammes.
Citric acid	2 to 3 "
Iron chloride	4 to 6 "
Water	85 cub. centimeters.

The prepared material is printed under the drawing, and then immersed in a bath of yellow prussiate of potash, or of nitrate of silver, the picture thus developed being afterward put in water slightly acidified with sulphuric or hydrochloric acid.

A LARGE CRANK SHAFT.—The crank and crank shaft of the City of Rome, the new Inman liner, are approaching completion at Messrs. Whitworth's. The crank has three throws, each piece weighing about 20 tons, and the whole about 61 tons, while the shaft of fluid compressed steel forged hollow will weigh 18½ tons when finished.