AN IMPROVED DUMPING CART.

A simple and convenient cart, that is easily constructed and operated, and which combines lightness with strength, is shown in the accompanying illustration, and has been patented by Mr. Mark A. Libbey, of South Berwick, Me. It has a cylindrical body pivoted between the wheels, and a sliding cover, the body being operated by a gear mechanism. The body is preferably of sheet metal, with its ends slightly cone-shaped, each end having a thickened central portion, from which project trunnions into the wheel hubs. On these trunnions is pivoted a U-shaped frame, to the front part of which the shafts are attached. On one or both of the body ends is an annular flange or pulley, to which are secured the ends of a chain which passes over a sprocket wheel on a shaft held to turn in lugs on the under side of the U-shaped frame, just in advance of the body. On this shaft is a gear wheel meshing with a gear on the lower end of a vertical shaft, supported to extend up near the driver's seat, and provided at its upper end with a crank, so that by turning the crank the cylindrical body may be turned on its axis. On the transverse shaft are also ratchet or cog wheels, adapted to be engaged by teeth of spring-held arms projecting upward through the foot platform, whereby the body is held in the desired position. The sliding cover has lugs on its ends to overlap the edges of the cylinder and hold the cover in position thereon, and is provided with a spring latch to be engaged by a catch on the cylinder to hold the cover in closed position. In loading the cart the body is turned to bring its opening at the top, the cover being closed after loading. When the load is to be dumped, the driver opens the cover, and, by means of the crank on the vertical shaft, turns the body bottom up. A modified form of this invention is also provided, by means of which the horse may be brought closer to the load. In this case the chain and sprocket wheel are dispensed with, and the end of the body itself is provided with a gear meshing with another gear on the lower end of the vertical shaft extending up by the driver's seat, the body then being turned directly by means of the gears.

LIBBEY'S DUMPING CART.

ATKINSON'S CYCLE GAS ENGINE.

At the present time our attention is attracted by any device that promises to reduce the cost of producing power, or, to state it with greater accuracy, utilizes a larger percentage of the energy stored in coal. At the present time the gas engine leads, developing an indicated horse power from less than 1½ pounds of coal, results of one test showing 1·11 pounds per indicated horse power per hour, and that, too, in a 12 horse engine developing but 7 or 8 horse power. If such results as these can be obtained in every day practice, the gas engine is the coming motor. In this country its development has not progressed so rapidly as in Europe, and we are but beginning to realize that it is a more economical motor than the steam engine and will eventually supersede it. It has been and still is generally regarded as a motor suitable only for small powers, but that the contrary is the case, and that large, powerful gas engines can be built, the mechanical world is just beginning to see. This being the case, those engaged or interested in the production of power should familiarize themselves with the history of the gas engine, with the principles controlling its operation, and with the mechanical devices adopted in the various engines that have, from time to time, been placed on the market; they would then be in position to judge intelligently of the relative merits of the surviving engines.

It is not our intention to give the history of the gas engine, but merely to call attention to the conditions necessary to obtain the greatest economy. Clerk, in his work, "The Gas Engine," refers to a pamphlet published by Beau de Roches, in Paris, in 1862, and we quote: He states that to obtain economy with an explosion engine, four conditions are requisite:

1. The greatest possible cylinder volume with the least possible cooling surface. 2. The greatest possible rapidity of expansion. 3. The greatest possible expansion. And 4. The greatest possible pressure at the commencement of the expansion.

In using boiler tubes, he states the efficiency of the heat transmitted increases with the reduction in the diameter of the tubes. In the case of engine cylinders, therefore, the loss of heat of explosion would be in inverse ratio to the diameter of the cylinders.

Therefore, he reasons, an arrangement which, for a given consumption of gas, gives cylinders of the greatest diameters will give the best economy, or least loss of heat to the cylinder. One cylinder only must be employed in such an engine; but loss of heat depends also upon time. Cooling, therefore, will be proportionately greater as the working speed is slower.

The sole arrangement capable of combining these conditions, he states, consists in using the largest possible cylinder, and reducing the resistance of the gases to a minimum. This leads, he states, to the following series of operations:

1. Suction during an entire outstroke of the piston. 2. Compression during the following instroke. 3. Ignition at the dead point and expansion during the third stroke. 4. Forcing out of the burned gases from the cylinder on the fourth and last return stroke.

The ignition he proposes to accomplish by the increase of temperature due to compression. This he expects to do by compressing to one-fourth of the original volume.

The only successful engines that have been placed on the market are those embodying the above cycle. All others have had but a short life and have disappeared. Some of these have been resurrected under different names, only to repeat the same history.

In designing an engine to meet the conditions laid down above, the first may be provided for by careful designing, and the second by high piston speed; this being limited by the time necessary for complete combustion. But the difficulty begins with the third, as the greatest possible expansion can only be obtained by expanding the charge to a volume greater than the original volume; for when expanded to the original volume only, the charge will have a high terminal pressure, and if expansion is only carried to this point, the products of combustion will be discharged with a large amount of energy not utilized.

The difficulty also continues with the fourth, as the purer the mixture the higher will be the pressure at the commencement of the expansion, and in an engine in which the four strokes are of equal length, it is impossible to obtain a pure mixture, owing to the fact that the necessary compression space is, after the exhaust stroke, left full of the products of combustion, and these, of course, adulterate the charge and reduce the pressure. There is also another disadvantage attending the use of such a compression space, and that is, that it places a limit upon the size of the engine; for if an engine of large power is built, the cooling surface of the cylinder will bear such a small ratio to the volume of the cylinder that the percentage of heat lost to the surfaces by the products of combustion during the exhaust, suction, and compression strokes will be very small, and the temperature of the charge will be so high that when the heat due to compression is added a premature explosion will take place, and the motion of the engine be retarded or reversed. Consequently, to increase the power of engines after certain power has been reached, one or more cylinders have been added, forming, in reality, separate and distinct engines connected to one crank shaft.

A new engine has, however, appeared which not only overcomes the difficulties presented by the third and fourth conditions, but also the latter trouble; and, in order to emphasize the statement that it approaches more nearly than any other to the ideal engine, we would call attention to De Roches' cycle as followed in engines of the Otto type.

During the suction stroke the charge is drawn in and mixes with the products of combustion. The next stroke compresses it, ignition then takes place, and it is expanded to the original volume only, and the terminal pressure is high. The products of combustion are then expelled by the fourth stroke.

The new engine referred to—Atkinson's Cycle Gas Engine—performs all these operations in one revolution of the crank shaft. Fig. 1 is a perspective view of the engine and Fig. 2 a sectional elevation, showing only the mechanism by which the above operations are effected. It will be noticed that the different operations are obtained by the addition of but two parts—a link, which vibrates through the arc of a circle, and a connecting rod, and by changing the position of the crank shaft in relation to the cylinder. The outer end of the piston connecting rod is attached to a pin passing through the crank connecting rod, and the latter is connected to the link. The different centers are so placed in relation to each other and to the center line of the cylinder that the center of the pin to which the piston connecting rod is attached travels in a curve resembling the figure eight, passing over the portion, S E, during the suction stroke, over C W during the compression stroke, over W E during the working stroke, and over E S during the exhaust stroke. The figure shows that the compression stroke is shorter than the suction stroke, that the working stroke is almost double the suction stroke, that the exhaust stroke ends with the piston as close to the cylinder cover as it is possible mechanically to have it, and that the working stroke takes place in one-quarter of a revolution. It is apparent that, with a given rotative speed, greater rapidity of expansion can be obtained with this engine than with engines of other types, and that it is possible to expand the charge to such a volume that the terminal pressure will be reduced to the lowest practical point, and that, owing to the purity of the charge, the greatest possible pressure will be attained at the commencement of the expansion. Owing to the fact that practically all the products of combustion are expelled, the incoming charge will attain no higher temperature in a large engine than in a small one, and, consequently, large sizes can be built.

This, certainly, is a remarkable piece of mechanism to accomplish such results by such simple means; and the results of tests made by disinterested parties show that the friction cannot be any greater than in an ordinary engine. If this engine should prove a commercial success, operated in conjunction with a producer for making cheap fuel gas, there can be no question as to its superseding all other prime motors. We understand it has proved successful in England, and is now being manufactured in this country.

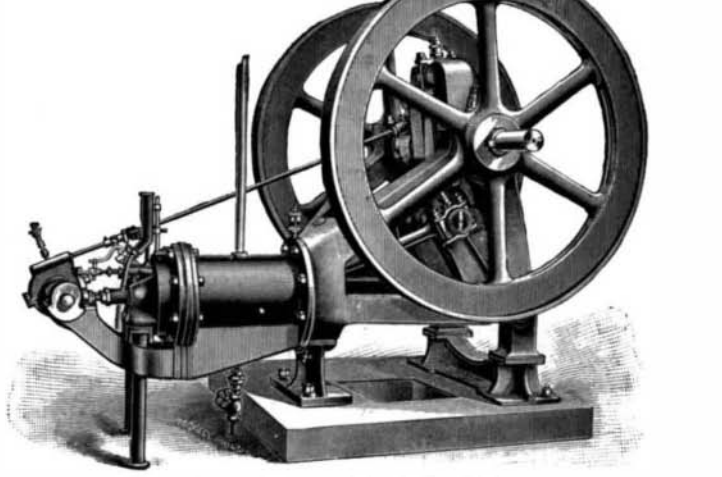

Fig. 1.—THE ATKINSON GAS ENGINE.

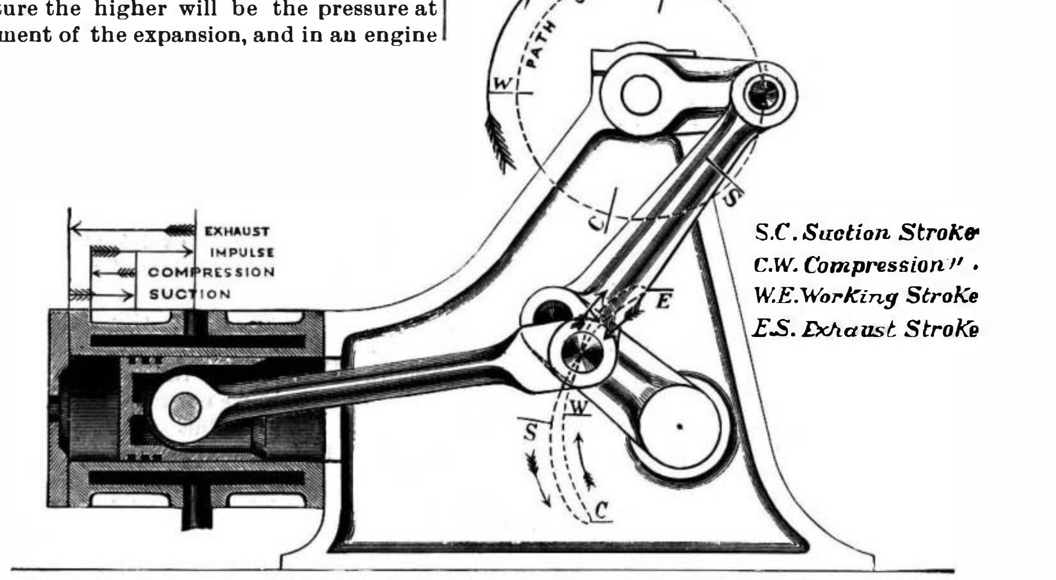

Fig. 2.—LONGITUDINAL SECTION OF THE ATKINSON GAS ENGINE.

BRICKS are enameled by being dipped into a slip composed of finely ground enamel suspended in water. They are then dried and fired a second time.

On Poisons.

Dr. Meymott Tidy's emphatic oratorical style is familiar to and popular with London lecture audiences. The announcement that he would explain to the members of the London Institution "What is a poison?" brought together an unusually large audience on Monday, March 16. The lectures delivered at the institution are marked by several excellent features. There is a chairman, we believe, but he never speaks; there are no votes of thanks. The lectures begin punctually at one hour and finish punctually on the stroke of the next, and, unless you take a very prominent seat, you can glide out at any time you like without disturbing the rest of the company. Nobody glided during Dr. Tidy's lecture. He knows poisons very intimately, and he can tell what he knows in the most attractive style. We do not know how Dr. Tidy says "Good morning," but can hardly imagine that he would say it without introducing some dramatic effect.

Toxicology, he said, is the science of poisons. How comes it to be called toxicology? The Greek word from which it was derived meant a bow, and was used to signify not only the bow but also the arrows used with it. Dioscorides, in the first century, first used the term in connection with poison, which was at that time associated with the art of smearing the arrow heads used in warfare. Thus the meaning of the word tended to enlarge itself, trying, as words do, to keep pace with scientific progress. In that Greek word *toxon* was to be found not only the derivation but the early history of poisoning.

A grim interest gathers round the history of poisoning. No doubt the first poison employed was that obtained from the snake. The subtle serpent first taught the art to man, but in those early days it was used in open warfare. But man grows wiser, and perhaps wickeder, and it was reserved for later times to taint the cup of friendship with the deadly venom. Was the suggestion too wild that if it had not been for the invention of more effective means of slaughter, the chemist would still have been called in to aid in the art of poisoning weapons? But if he had missed his chance in that respect, he could still look back to the early days of toxicology as the cradle of science.

This art of poisoning arrows went back to quite prehistoric times. Mythological legends tell how Hercules dipped his arrows in poison to slay the Hydra, and how his jealous wife clothed him with the coat of Nessus, wherewith she vainly hoped to regain his affection, but only occasioned the sufferings which destroyed him. Strange it is to note how old is the knowledge of the poisonous nature of putrid blood, and of putrid animal fluids generally. This was recognized in very early times. The blood of a red-haired woman was regarded as especially poisonous. And up to almost recent times blood itself was thought to be poisonous. A king of Egypt was said to have been killed by drinking bullock's blood, and not more than a century and a half ago Blumenbach induced one of his students to drink the same, while he and his class stood by to watch the symptoms.

The stories of Circe and Medea, of Drusilla and Locusta, of Tiberius and Nero, of Toffana and the Medicis, were tempting, but were not the subject of the lecture. He had to deal with the question, "What is a poison?" The law has not defined it, but the law frequently demands a definition from scientific witnesses. The popular definitions of a poison are none of them sound, much less scientific. He had searched every dictionary he could put his hands on and believed that the definition in every case amounted to this: That a poison is a drug which kills rapidly when administered in small quantities. But many poisons do neither the one nor the other. The terms "small quantity" and "rapidly" were about as definite as the classical piece of chalk. "Here," said the lecturer, holding up bottles containing nearly an ounce of each, "are oxalic acid and sugar of lead, in about the quantities necessary to be taken to make sure of a fatal result. But we should hardly call these small quantities. And yet these are certainly poisons. Moreover, many of the most certain poisons are very slow in their action."

Dr. Tidy defined a poison as "any substance which, otherwise than by the aid of heat or electricity, is capable of destroying life by chemical action on the tissues or by physiological action on the organs of the body. There's a good lot of it," he added, "but I can't get it into fewer words." Of course, he explained, mechanical means were excluded. You might kill yourself by swallowing pins, but pins were not poison. Nor is a substance a poison which destroys life by merely blocking out that which maintains life. Then he took two glass jars, one containing carbonic acid gas and the other nitrogen, and dipping a taper in each, showed that it was easily extinguished. "So would you go out," he said, "if you were introduced into either atmosphere. But the nitrogen is not a poison. With 20 per cent of oxygen in it you can live quite easily; but neither 20, nor 40, nor 60 per cent of oxygen would enable you to live in an atmosphere of carbonic acid gas, which is a poison." He proceeded to say that nature hates classification, but he must give illustrations of three classes of poison. First, he alluded to sulphuric acid, and showed a part of a stomach charred by the action of this poison. A caseful of stomach and other tissues was shown, illustrating the effects of various poisons, but time did not allow of these being explained. The charring effect of sulphuric acid was explained by the familiar experiment of pouring sulphuric acid on a thick solution of sugar, showing that the effect of the oil of vitriol was to abstract the water, and thus to cause the "charring." The stomach dies. That is molecular death, and this death soon extends to the rest of the body.

Carbonic oxide furnished an illustration of a second class of poisoning. A bottle of this gas was lighted at the neck, and burned with a blue flame, "the same as that which you see just over your fire stoves. This gas is always present in coal gas to the amount of 5 or 6 or 7 per cent, and gives it its poisonous character. I don't think carbureted hydrogen burning in the gas jet is at all poisonous. I think all the poison is in the 5 or 6 per cent of carbonic oxide. How does it destroy life? In this way: The active agent of our blood is the red coloring matter called hæmoglobin. This substance abounds in wonder. I think it is the most marvelous compound, chemically, with which we are acquainted. To live and thrive and flourish we must get albumen and albumenoids. We cannot form these ourselves, but the plant can. The power of building up albumenoid substances is limited to the plant laboratory. Man has the power to change one albumen into another. He can convert albumen into peptone, for example; he can break them up into albumen lower in the scale; but he cannot go higher—*with one exception.* That exception is hæmoglobin, the red coloring matter of the blood. This hæmoglobin, which comes on the scene through a stage opening of which we know not the whereabouts, has a strange property. As a rule, substances which combine with oxygen with the greatest difficulty can be separated from it with the greatest ease; and, conversely, substances which combine with it with great ease can be separated from it only with the greatest difficulty. Gold is one of the most difficultly oxidizable of bodies, and its oxide is most easily reducible. Potassium and sodium, on the other hand, combine with oxygen with the greatest ease, but it required the genius of a Humphry Davy to separate them. Hæmoglobin is an exception in this respect also. It combines with and separates from oxygen with equal facility. The life of man depends on the perfection with which hæmoglobin performs its function as oxygen receiver, oxygen carrier, and oxygen deliverer. But when a man takes carbonic oxide, hæmoglobin combines with this almost as easily as it does with oxygen, and, having taken it, the carriage is full; it cannot take up any oxygen. But, worse than that, it cannot get rid of the carbonic oxide; the carrier cannot unload. In scientific phraseology, the combination of hæmoglobin and carbonic oxide is a comparatively stable compound. The man dies because the sequence of oxidation is interrupted."

Strychnine was the third illustrative poison introduced. This poison was said to destroy life by physiological action. "And what do I mean," said the lecturer, "by physiological action? I mean just simply that I don't know what I mean. Not knowing how it acts, I use the phrase physiological action to conceal my ignorance. It would never do to say we did not know how drugs act, so we say it is a physiological action. But we know one thing about the action of strychnine. We can tell by means of the spectroscope that the fits resulting from the administration of strychnine coincide exactly with the abstraction of oxygen from its compound with hæmoglobin. Why it kills we do not know, and let me remark that it is one of the highest forms of knowledge to know exactly the limits of our knowledge. In fact, the term physiological action no more explains death by poisoning than the term catalysis explains fermentation."

But can chemical investigation throw no light on the reason for the poisonous character of certain elements and certain compounds? Given that we know many facts about phosphorus, for example—its atomic weight, its relations to the periodic law, its spectrum, and so on—ought we not to be able to foretell, in some degree, its action? This subject was studied first by Blake in 1841, and afterward by Rabuteau in 1867, and by other investigators. At first it was thought that the physiological activity of the elements increased the ratio of their atomic weights, but it was afterward noted that the reverse was the case in certain groups, and the end of the researches was the conclusion that neither in regard to elements nor compounds could any reliable rule be formulated. In inquiring into this subject further difficulties occur in the strange allotropic forms of certain elements and the isomerism of the organic compounds. Illustrations of these conditions were adduced in yellow and red phosphorus, the first of which, the lecturer said, would be fatal in 2 grain doses, while of the other an ounce might be taken without injury, as far as he knew. Ozone was another mysterious body. Every one knows that oxygen is the great life-preserver and life-sustainer. Ozone is oxygen in which three atoms are condensed into each molecule instead of two. But if you put a frog into ozone, into this condensed oxygen, it will soon close its eyes, its respiration will fall rapidly, and it will die simply for want of oxygen. As an illustration of isomeric bodies take these two substances, morphia and piperine, send them to a chemist for analysis, and his report will be that they are identical in composition; and yet the one is of all things in the world that which is most calculated to send one to sleep, and the other is of all things in the world the compound to keep you awake.

In ancient times the arts of witchcraft, medicine and poisoning were bound up together. The Greek word pharmakist was used to signify dispenser of medicines, a witch, and a poisoner. One of the great services that science has rendered to mankind has been to separate these notions. The modern pharmacist no longer requires the stuffed crocodile to watch over his incantations, to aid in the composition of his medicines. And science has done more than this. It has rendered impossible the secret villainies of the old poisoners. It follows the traces of secret treachery with a bloodhound scent, and will ultimately tend to repress entirely the crime of poisoning.—*Chem. and Drug.*

Accelerated Fermentation.

The invention by F. Hofmeister, Munich, Germany, consists in spreading the ferment used over a large surface immersed in the liquid to be fermented. For this purpose the fermenting vessel is provided with a large number of diaphragms, bars, bands, or strips, preferably consisting of some pure tasteless fabric. In order to take up as little vat space as possible the supports are made very thin, and the surfaces are placed in an inclined position, and in some cases perforated to allow of the ready escape of the carbonic acid.

The fermentation of wine, beer, etc., is started as follows: The ferment-supporting surfaces are sprinkled with old must, beer, etc., and the tun is closed and a current of air aspirated through the apparatus for thirty-six hours. The must, wort, or other liquid is then run into the tun, when fermentation soon commences. Or, the arrangement of surfaces may be at once placed in a fermenting liquid, with the result that fermentation will be considerably accelerated. In order to produce sparkling drinks the tun and its ferment carriers are placed in a strong vessel provided with a lid, which is fitted with a pressure gauge, tap, and manhole. After fermentation the liquid may be drawn off through a tap at the bottom, which communicates with the fermenting vat. Two forms of the above apparatus are described. According to temperature and other factors, a pressure of four to five atmospheres is developed in a period of one to six days. If fermentation has been carried on slowly (three to six days), the wine may be drawn off quite bright, provided the apparatus has been kept at rest.

The use of ferment-bearing surfaces is of great importance to breweries. Fermentation can be carried on at a lower temperature than usual, and since fermentation goes on rapidly, a smaller number of vessels will suffice. The invention will also be of great value to distilleries, leading to a considerable economy in time. The losses which usually occur owing to the passage of unfermented matter into the wash, and to acid fermentations produced at the expense of alcohol, will be entirely prevented by the rapid fermentations at comparatively low temperatures obtainable by the use of this system. The working efficiency of the apparatus increases with its age; only the deposits on the surfaces should be withdrawn about every two months.

An Englishman's Views of American Trusts.

Mr. Plimsoll, a member of the English Parliament, in an article in the *Nineteenth Century*, has discovered that in the United States no less than seventy-one large combinations were organized in 1888-89. Some of these include many others, in all 490 "trusts" were organized in two years. They have been formed to control almost every branch of industry, including the manufacture of paper bags, coffins, and pickles, and it is computed they include no less than $2,000,000,000, or considerably more than two-thirds of the entire manufacturing capital of the United States. Mr. Plimsoll is afraid that further attempts will be made to foster and develop this odious trust system in England, and he urges her legislators to rouse themselves promptly to the danger of this fearful menacing calamity. He suggests that a select committee or a royal commission should be constituted without loss of time, "to inquire into the whole of the subject."

Lord Salisbury is quite a distinguished savant as well as a renowned statesman. In a recent lecture before the Chemical Society of London, he said: "Astronomy is, in a great measure, the science of things as they probably are, geology is the science of things as they probably were, chemistry is the science of things as they are at present." To these adds the *Electrical Engineer*, "electricity is the science of things as they probably will be."