LIQUID CARBONIC ACID AS A MOTOR.

In the search for cheap motive power, to which inventors of all classes are more or less giving their attention, the utilization of carbonic acid gas has been suggested, and practised to some extent, notably in the propulsion of submarine movable torpedoes. The Lay torpedo, of which some time ago we published a description, was driven and steered by this gas, compressed into a liquid state. The advantages offered, as compared with compressed air, are that, by the use of the liquid, a much larger quantity of motive power can be stored in the same space, allowing the employment of smaller and thicker vessels; and of the gases that may be liquefied, carbonic acid can be prepared most cheaply and readily. There are two methods by which carbonic acid gas may be reduced to a liquid state, first, by the aid of the pressure of the gas as it is evolved; secondly, by mechanical compression. The first process necessitates the repeated charging of a reservoir, producing a series of condensations; but in each charging a large quantity of gas is lost, since all that does not condense must be blown off in order that the generator may be refilled. The apparatus is simple but troublesome to work.

By the second method, which is in every way preferable, the gas is compressed, into a receiver immersed in a cooling mixture, by a condensing pump. This plan is that adopted by the United States Torpedo Station, at Newport, R. I., for the generation of the large amount of liquid (some 700 lbs.) needed to fill the flasks of the Lay torpedo. The apparatus used, while in principle very similar to that employed in the manufacture of soda water, is especially adapted to the work of producing the gas under very heavy pressures by many novel and important alterations. Its construction will be understood from the annexed engraving, which, with the facts given herewith, we extract from a paper prepared by Mr. Walter N. Hill, S. B., chemist of the Torpedo Station, and published under the auspices of the Ordnance Department of the Navy.

There are two generators, A, so that while one is in action the other may be emptied and recharged. These are of cast iron, and receive the marble dust and water. The wheel, E, serves to rotate an agitator within the cylinder. The sulphuric acid is contained in the smaller vessels, B, and admitted to the generators by valves operated by levers, *a*. C C simply contain water for washing the gas. The acid, admitted from B, acts upon the marble dust and generates carbonic acid gas, which passes up the lead pipe, *b*, to the cross, *c*. To this last are attached a pressure gage, *d*, and a tube leading to B, serving to equalize the pressure in that vessel. To the lower branch of the cross is attached a pipe which extends to the bottom of vessel, C, through the water of which the gas bubbles up, and finally is led away by pipe, *e*, to the receiver G. In this receptacle a supply of gas is kept, from which the pump can draft for a short time, if for any reasons both generators should be out of action. Also, if priming occurs, the material carried over remains in the vessel and can easily be removed. The gage, *f*, marks the pressure of the gas which the pump is taking.

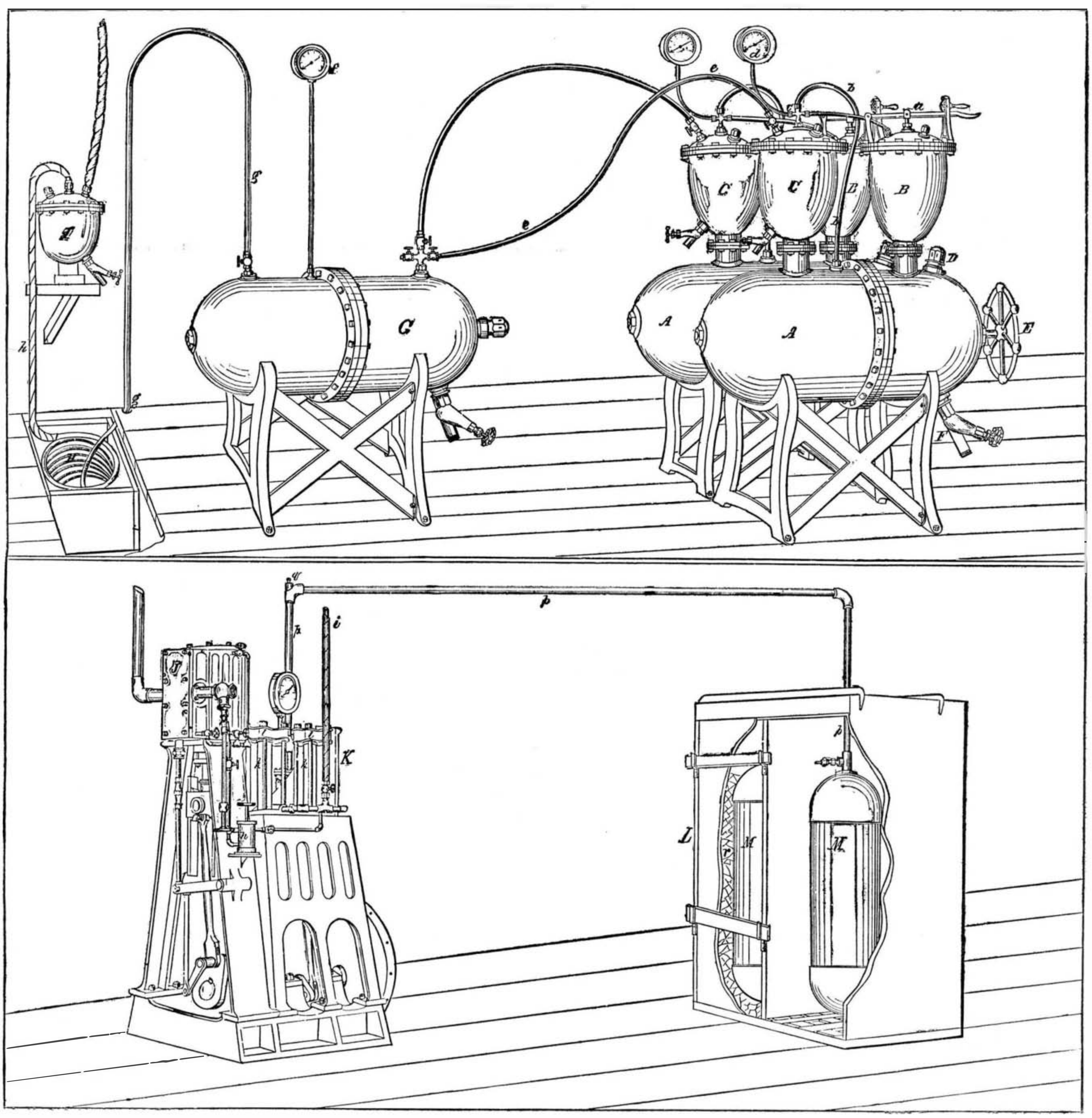
From the receiving vessel, the gas traverses a coil of lead pipe, H, which is surrounded by ice water, thence goes through an empty vessel, I, which catches any foreign matter carried over, and finally escapes by the pipe, *i*, to the pump. The latter resembles in form the Burleigh air compressor. The steam cylinder, J, is 15 x 7 inches, and there are two compressing cylinders, *k k*, of steel, each 2¼ inches in diameter by 10 inches stroke, provided with steel pistons in which are small steel valves opening inwards. The rods are driven by connecting rods and cranks from the crank shaft of the steam cylinder, and the gas cylinders are well jacketed, as shown broken away at K. The gas enters the bottoms of the cylinders; and as the valves in the pistons close on the up stroke, the gas above is compressed and forced into the composition boxes, *l*. Thence it passes to an oil drip box, *m*, and thence by heavy pipes to the receivers, M, which are surrounded by freezing mixture, the drainage from which is carried to the coil, H.

One of the most important features of the apparatus is the supplying of the gas at high pressure, averaging 100 lbs. per square inch, to the pump. If the gas were drawn from the generator at atmospheric pressure, it would have to be compressed to $\frac{1}{40}$ its bulk to average 600 lbs., the pressure of liquefaction; but if taken at 100 lbs. only to $\frac{1}{16}$. In addition, the strain on the pump is greatly diminished.

It is estimated that the cost of gas made by the machine described, under favorable conditions, will not be greater than 15 cents a lb. This mode of preparing the liquid is not available on board ship, nor is it suitable to localities where ice is not attainable.

Mr. Hill has, however, devised another improvement, wherein the use of ice and salt is done away with, and a more uniform cooling of the receivers obtained. By means of an air compressor, air is compressed into a strong tank at 70 to 80 lbs. per square inch. This is used to drive the pump. By a simple arrangement, the exhaust from the driving cylinder of the latter is used to keep the flask, receiving the compressed gas, cold, the vessel being placed in sea water, which may easily be reduced in temperature below 32° Fah.

Liquid carbonic acid has a tension, at —4° Fah., of 322·5 pounds per square inch, and at 94° Fah. of 1,200 lbs. Under ordinary circumstances, the highest temperature above mentioned may be attained, and the corresponding pressure reached, so that the proper construction of vessels for containing it is a matter of considerable moment. After experimenting, the flasks found most satisfactory were those made of fine sheet steel (0·045 inch thick) in successive layers,



MANUFACTURE OF LIQUID CARBONIC ACID FOR MOTIVE PURPOSES.

four being commonly employed. The sheets are wrapped so as to break joints around a cylinder, and the last one or shell is lapped and riveted. Then all are made into a solid cylinder by means of pure tin, which is melted and worked in from the inside with the aid of gas blowpipes. The heads are made of cup-shaped pieces of steel, placed one within the other and sweated together with tin. The lengths of the flasks vary from 7 to 4 feet, and the diameters are 12 inches along the body and 13¼ inches at the heads. One flask which was tested to destruction gave way under a pressure of 3,136 lbs. per square inch. The total strains borne are calculated as follows: At 1,200 lbs., longitudinal strain, 19·104 lbs.; tangential strain, 38,800 lbs. At 1,365 lbs., longitudinal strain, 21,731 lbs.; tangential strain, 44,152 lbs.

Very probably it will yet be found that liquid carbonic acid will receive many applications as a source of motive power. It has only to be made cheaply, and it will be extensively used.

The Palace Hotel.

Visitors to San Francisco will hereafter be struck with a new and conspicuous feature in the face of the young giant town. Seven stories high, with a base of 96,250 square feet, at the corner of Market and New Montgomery streets, now looms up the Palace Hotel. Its huge brick walls are ribbed from top to bottom with tiers of bay windows, and spotted like the sides of an ironclad with bolt heads that clinch the great rods running over and under and through and through the building, making it a kind of Cyclopean open work iron safe, filled in and lined with fireproof brick, where all treasure of human life and limb should be secure against fire or earthquake while the Peninsula stands. It is, indeed, to this element of security that we would draw special attention, while so many buildings are going up today in our great cities, which are a disgrace in flimsy and tawdry pretension, and a danger in their inflammable and carelessly thrown together materials.

The whole work of constructing this hotel was done by the day's work and not by the piece, and so done carefully and well. Seventy-one partition walls of brick run from the foundation up through the roof, and two feet above it, and the roof is of tin. There are four artesian wells, two in each outer court, with a tested capacity of 28,000 gallons of water per hour. Under the center court is a 630,000 gallon reservoir, with walls of brick and cement five feet thick and buttressed. On the roof are seven tanks of boiler iron, with an aggregate capacity of 138,000 gallons. Seven steam pumps force this water through the whole house by a system of arteries and mains, with 392 outlets in the corridors, provided in each case with three inch hose, from 10 to 100 feet in length, with nozzles. Under the sidewalks without the building, there are eight four inch fire mains connecting with the city water, by means of which the city engines can, if found necessary at any time, force water into the hotel mains.

In every room and passage there is an automatic fire alarm, by which any extraordinary heat will be instantly and noisily known at the central office of the hotel; and six watchmen will patrol day and night every part of the structure, and touch, half hour by half hour, at seventy-nine stations, which will report by electricity and fix the place and time of a dereliction of duty.

Through the heart of the hotel from top to bottom runs a fire brick tunnel, within which is a solid brick and iron staircase opening on each floor. In five like tunnels are five elevators, run by hydraulic power, besides six additional stairways from garret to basement. Wood is avoided where possible. In the construction of kitchen, oven room, bakery, store rooms, steam pump room, water heating room, coal vaults, ash vaults and shafts, and corridors, wood is supplanted by asphaltum and marble, iron beams, and brick arches. If the Palace Hotel can burn, the lessons of Chicago and Boston are lost, and all human precaution is vain against fire in this year of our Lord eighteen hundred and seventy-five.

Architect J. P. Gaynor was instructed by the owners to travel and study the best hotels elsewhere before submitting his plans for the Palace Hotel, and Warren Leland—mine host of the old New York Metropolitan Hotel, of the Leland family, famous as hotel keepers—was appointed lessee of the house, and manager of all things. The sunning and ventilation of the 755 rooms for guests are excellent, every room opening on the open light, having a fire place, and a separate flue of four by eight inches running clear through to the roof. Every second room has a bath room attached, most rooms are twenty feet square, and none of a less size than sixteen by sixteen feet. Two thousand and forty-two ventilating tubes open outward on the roof of the hotel.

Three great cañons or courts, cut down from roof to base, air and lighten the mountain building. The center court measures 144 by 84 feet, is covered with glass, made brilliant by the lights of the pillared verandahs surrounding it, floor above floor; with a tropical garden, fountains, statues, an instrumental band of music in the evenings, and a circular carriage drive fifty-four feet in diameter. Opening upon this "garden floor" there is an "arcade promenade," four yards wide, with a show window looking on the promenade from each of the stores under the hotel. Letter tubes, pneumatic dispatch tubes, and electric bells knit all this miniature Palais Royal and the hotel into one body of wonderful life

Ministering to the 1,200 guests that can be accomodated are four clerks, two book keepers, a French head cook who is a brilliant particular star in his profession, five assistant cooks of rising name, and three specialists—namely, a chief confectioner from Milan, a chief baker from Vienna, and "Muffin Tom" from New York, an old negro the fame of whose egg muffins and corn bread has made him the aristocrat of his race for the last half century from Charleston to Long Branch. The 150 waiters are to be negroes also. Forty chambermaids and a host of Chinese will see that the beds and bed linen are white and fresh. This is the kind of hotel we keep in San Francisco.

From China and India and Japan a stream of invalids and visitors pours yearly in upon this city, the great sanitarium of the future for the languid oriental world. From the islands of the peaceful sea, from our own east and north, from Spanish America, a great host shall make a Babel of the Palace Hotel, whose builders have not been confounded. Its white towering walls, dotted with the gilded iron bolts that bind the great rods of the building together, shall be familiar to strange eyes from far lands. The sick down easter shall abandon his nutmegs of wood and satisfy his soul with the grapes and the oranges of our State; yellow aristocrats from Siam and tawny revolutionists from Bogota shall join hands and pass the sirup over the steaming triumphs of Muffin Tom.

We have seven big world wonders now: the Bay of San Francisco, the Central Pacific Railroad, the Big Trees, the Bonanza, Yosemite, the Geysers, the Palace Hotel—and Assessor Rosener.—*Overland Monthly.*

Scientific Courtship.

Young Molly met Christopher down by the farm,
With his analysis
And his catalysis
And his dialysis.
What would he do there!
He came down to woo there,
He came down to sue there,
To bill and to coo there,
Not to fill all her soul with alarm.

O! Science, 'tis thus that a fair maid you win,
With parthenogenesis
And alterogenesis
And heterogenesis
And other such things;
For Love, he has wings
And with him he brings
Full many such things
In the ears of fair maidens to din.

Young Christopher came with his finest brochures,
On trilobites
And troglodytes,
Theodolites
And such delights,
And he said, my dear, these are yours,
Yes, they're yours.
Love may come and love may go,
Science endures.

The heart is a stubborn thing,
And conical in shape;
A remnant which with us we bring
From our ancestral ape.
It drives the blood to Molly's cheeks,
She opens her ruby lips and speaks;
Her mitral valve plays
In the wildest of ways;
Her columna carnea,
Gives her an idea
By the way that it acts;
And, accepting the facts,
She then and there agrees to become
The partner of his scientific home.
—*Journal of Applied Chemistry.*

Correspondence.

Steam Boiler Phenomena.

To the Editor of the Scientific American:

In your article on this subject on page 193 of your current volume, you give a very interesting account of the result of injecting water into overheated boilers. The account is more valuable than usual, for the conditions seem to have been carefully observed and the results noted; and although, as you observe, they seem to be contradictory, I believe they can be explained.

In calore, vis—in heat is force or energy This has been for many years my maxim; and from this point, I will endeavor to explain the two phenomena.

In the first case, the boiler was absolutely dry, and heated to from 600° to 1,000° Fah., the steam pressure being 0. Water was injected, and the pressure suddenly rose to 190 lbs. per square inch. The conditions are then as follows: An unknown quantity of water is brought in contact with an unknown quantity of iron heated to from 600° to 1,000° Fah. If, now, the arrangement of the injection pipe and pump were such that 1 lb. water injected at the first stroke would come in contact with 9 lbs. iron heated to 600° Fah., the water would absorb the heat and cool the iron. The resultant temperature would be 300° Fah. As each square foot of the iron in such boilers weighs about 12 lbs., and as the water injected by the first stroke may, and usually would, come in contact with a much larger surface than 1 square foot to each lb. of water injected, it is evident that the water would be heated to a higher degree of temperature, and steam of a higher pressure would be formed. If the quantity of water injected is small, and the heated surface with which it comes in contact large, an enormous pressure can be suddenly created in a confined space. If, on the other hand, the quantity of water is large, and the surface of the iron with which it comes in contact small, the water will be heated less; and, if heated below the boiling point, no steam is formed, as the limit of the capacity of the water to absorb heat is not reached. If, therefore, the first boiler were set so that the injected water could spread over a large surface, a sudden and high pressure would be the result; and if set so that the water could come in contact with a small quantity of iron, that is, lower at the end at which the water is injected, very little pressure would be produced, and the heat in the iron would be gradually absorbed by the water without any injurious results.

In the second case, the conditions were similar, and "an independent pump was at hand, and was put on with a full supply of feed. The steam rose to 20 lbs. by the gage, and as suddenly fell, the steam gage indicating a complete or partial vacuum." Reasoning from numerous practical experiments, I conclude that, at the first stroke of the pump, a quantity of water was driven over sufficient surface to heat the same suddenly, and thus produce the steam pressure indicated by the gage; and the second or subsequent stroke injected a quantity of water into the steam, and condensed the same, thus producing a vacuum. If the feed end of the second boiler were lower (as it should be) than the other end, and the feed pipe entered the end of the boiler some distance above the plate, a full supply of water would produce this result.

If heat be force, a boiler heated to 1,000° Fah. contains an immense quantity of stored-up energy; and a quantity of water less than one tenth in weight of the heated iron will become the agent through which this energy is exerted, by absorbing the heat and being changed from a cohesive fluid to an expanding gas, and thus exert an enormous and (if suddenly liberated) dangerous force. When, however, the same quantity of heated iron is brought in contact with a much larger quantity of water, the great capacity of water for heat compared with that of the iron (12 to 100) will absorb the heat without producing even steam.

Experiments of the above kind should never be attempted, as it is criminal to thus risk life and property; the fires should have been hauled in both cases, and the boilers gradually cooled.

Boston, Mass. JOSEPH A. MILLER.

The Keely Gas.

To the Editor of the Scientific American:

In the communication headed "The Keely Gas," the author is laboring under some mistakes. I will endeavor to correct his statements.

He states: "It is well known that the molecules of all substances increase or decrease in size in proportion to the specific gravity of the substance, the lighter substance containing the larger molecules." I need hardly say that, if this were true, and were known to be true, it would at once dispose of the atomic theory.

As for his experimental proof: If (as I suspect) he uses oil as being lighter than water, I am not at all surprised at his result; for the adhesion of oil to a smooth surface is far greater than that of water; so that, on pouring on the oil, it would immediately flow to the glass and cause overflow of the contents. Your correspondent may try the experiment of filling two equal and similar glass vessels with oil and water respectively. He will find that he will be enabled to add more water than oil before overflow. Let him, however, use absolute alcohol (specific gravity 0·8), and he will find that, to two similar glassfuls of water, he will be able to add more alcohol than water before overflow.

In the case of heavy liquids, the heavier the liquid, the greater the volume which may be added without altering the apparent volume. Let him try mercury, and the result will be the same as if he had added an equal volume of water.

In his last paragraph he says: "For it is plain that it would be impossible for the larger atoms of molecules of the cold vapor to pass between the smaller molecules of metal.' However, unfortunately for this conclusion, it is known that hydrogen penetrates iron, that the products of combustion in a stove pass through the iron casing, and that gold is pervious to water.

I do not intend this to be in any way a defence of the Keely motor. W. B. M.

Hoboken, N. J.

A Water Motor.

At the Sulzbach Altenwald Colliery, near Saarbrucken, Prussia, machinery has been established for the transmission of power from a steam engine at the surface, by a column of water circulating under pressure, the circumstances of the case not admitting of the establishment of a direct-acting steam pump under ground. The mine is sunk 306 yards below the surface. The piston rod of the high pressure engine above is connected with the pressure plungers, each of which plungers is connected with the underground engine by a tube filled with water. The last mentioned engine consists of four pressure pumps arranged in pairs, and between each pair is placed the working plunger of one of the mine pumps. When the engine on the surface acts, the power is transmitted by one pressure plunger through one water tube to a pair of pressure pumps under ground, and thence to one working plunger, which either aspirates or forces air, according to its position. The opposite pair of pumps and connections work conversely. The water is forced into an air vessel, and thence through the rising main 303 yards in hight, in one lift to the surface. On the change of stroke, the water in the cylinder of the pressure pump rises in the second water tube and follows the retiring pressure plunger at the surface, the power supplied by the descent of water in one column being sufficient, with the exception of a slight allowance for friction, to effect its return in the other. If the cataract pauses of the engine at the surface are not too long, the discharge is practically continuous. *The Engineering and Mining Journal*, from whose translation of the German description we condense the above, adds that, at the Phœnix mine in Cornwall, England, an arrangement of simi