pointer would mark units of cubic feet. If to the axis of the units wheel a pinion of six teeth were attached, working into another wheel of sixty teeth, the latter would be a wheel of tens, and so on. The level must be kept at a constant point, and in wet meters there is generally a device for stopping the flow of gas the instant the level becomes too low.

Dry meters consist of a series of bellows inclosed in a case, and so arranged that they are alternately filled and discharged, the filling of one furnishing the necessary power for the discharge of another, and so on, each being successively filling and discharging. The reciprocal motion thus obtained is converted into a rotary motion by cranks set at right angles to each other and so arranged that a rotation is made for every time that the bellows are filled and emptied once. The cranks alluded to perform two offices, the first of which is to open and shut the valves which direct the flow of gas into the different bellows, and second, to give motion to a system of wheels and pinions having the number of their teeth in a tenfold ratio to each other, and impelling pointers over dials, precisely as described, for wet meters.

Now let us notice the obstructions to which the two kinds of meters are liable, and we shall see that their effect is against the producers of gas and in favor of the consumers. We premise, of course, that the meter is a perfect one when it is connected with the service pipe, and we will here state that the apparatus for testing meters is as certain and reliable as any used for sealing weights and measures, and that the sealing is performed by an officer bound and sworn to perform his duty faithfully, not in the employ of any company, and that his seal, according to law, must be upon every meter before it is used. The inspector's seal is evidence that, either himself or one of his deputies have tested the meter upon which it is placed and found it to be correct in its measurement. Wet meters may vary in their measurement by the axle (spindle) becoming fixed. In such case the gas would bubble up from beneath the fluid, the flow would not cease while the registering would stop—the producer, and not the consumer, losing the amount thus passed and not registered. They may vary from leakages, which sometimes occur in the buckets. In this case all the gas which leaks is lost to the producers. They may vary from the water level getting too low. When this occurs, the construction of the bucket wheel (drum) is such that the gas does not pass under the buckets, but gurgles up by the side and passes out without being registered. This fact alone would render a wet meter worthless (as it would place the sellers of gas at the mercy of the honesty of consumers), were it not provided against by an apparatus above alluded to, which closes the mouth of the service pipe and shuts off the flow of gas whenever the level becomes too low for correct registering. This apparatus consists of a hollow ball which floats upon the surface of the water. The ball is connected by a wire with a plug (valve), and when the level becomes, by evaporation or other causes, too low for accurate measurement, the plug stops the mouth of the pipe and obliges the consumer to supply the requisite amount of liquid to restore the level. The wire attached to the plug may sometimes stick in its guides. When this takes place the effect is evidently in favor of the consumer. Another cause of error may be the sticking of the axle of the bucket wheel, caused by tarry deposits from the gas. This must also favor the consumer, as the harder the meter works the more compression of the gas takes place in the buckets, so that more gas of a given density is required to rotate the drum than would otherwise be required. Of course, leaks through the outer case, or through pipes, cocks, or burners, which are supplied through the meter, are losses to the consumer, but he is solely to blame for such losses, and ought to sustain them. Dry meters are subject to variations from all the causes which we have enumerated, except those which depend upon the maintaining of the water level. Both may vary on account of temperature, and this is probably the only way in which the consumer can lose by their irregularities, as the gas, at an elevated temperature, will measure more for the same amount of illumination, than it will at a low temperature. It is therefore for the interest of the consumers to have meters set up in cool places.

The differences in the amount of gas bills may be attributed partly to the consumers. Burners which have been used long will generally pass more gas than new ones, as the apertures are frequently enlarged; and unless the flow of gas is stopped through the day, and at such times as the gas is not required, more or less leakage is liable to take place, and this leakage will be registered by the meter along with that which is burned. The great source of difference in gas bills is, however, the fault of the producers, who can vary the quality of the gas at pleasure. More poor gas, that is such gas as is poor on account of its deficiency in illuminating power, can be passed through burners without "blowing," than rich gas, or gas of high illuminating power. When such gas is furnished, the consumer unconsciously uses more volume for a given amount of light. In Europe, gas companies are obliged by law to supply gas of a specified richness; but in this country, if any such law exists, it is practically a dead letter, as the gas furnished by most companies is not kept up to any standard quality. This is the prime cause of the trouble. The meters are not to blame—they only measure quantity, and they do that well. If you purchase a quart of ostensible milk which has been diluted by a gill of Croton water, you do not blame the measuring cup.

The selling of gas by quantity only is an anomaly in domestic commerce, rendered possible simply because people in general cannot test its quality; other than by the effect it produces upon their pockets, after it is used, and the demand for payment cannot be evaded. The preventive is in the yet uninvented gas meter that shall register for quality as well as quantity, or in stringent laws that shall compel gas companies to make gas of a standard quality.

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ICE--ITS COLLECTION, STORAGE, AND DISTRIBUTION.

This substance, from time immemorial, in the countries of the Eastern Hemisphere, an article of luxury, has become one of prime necessity the world over. It enters into almost every house and place of business, contributing its grateful coolness to the water, rendered insipid and tasteless by the fervid heats of summer; it operates by its antiseptic power in the preservation of meats, vegetables, and fruits in a fresh condition, unchanged by the action of salt or brine; it freezes the creams and cools the mineral water of the confectioner, and aids the pharmaceutist in the condensation of distillates, the preparation of freezing mixtures, and the cooling suppositories and ointments, and furnishes a substitute of no mean value for distilled water. So varied and important are its uses, and so valuable is it in the operations conducted in the laboratory of the chemist and pharmaceutist, and so extensive the business and capital concerned in its collection and distribution, that a few notes respecting it have not been deemed as misplaced in this journal.

Fifty or sixty years ago Mr. Frederic Tudor, of Boston, entered upon the enterprise of exporting ice to the West Indies. He encountered the greatest difficulties in starting the business, among which was one which would bring a smile upon the face of any twelve-year-old boy of to-day. It was as difficult to charter a vessel to carry ice then, as it would be now to get one to carry nitro-glycerin, and he was obliged to purchase the vessel he at first employed, in order to show that ice is a safe cargo. For several years he continued operations in the face of difficulty, discouragement, and pecuniary loss, and it was not until twenty years after that he succeeded in making it remunerative. Since then the business has gradually increased, and within the last twenty years the growth has been very rapid, especially in that department devoted to the supply of the home consumption. The amount of capital employed, and the extent of the ice trade in the United States is something enormous. Full statistics are lacking, but occasional notices appear in the current news of the day which are extremely suggestive. A communication in the New York *Commercial Advertiser*, written by one who appears to know whereof he affirms, estimates the amount laid up for the consumption of the city trade in 1866, at 580,000 tuns, and during the past winter a statement appeared in some of the papers that there was stored for the consumption of 1868, 750,000 tuns. The writer is informed that the Knickerbocker, the largest ice company of New York, has a million of dollars invested in the business; and from the statements contained in the communication quoted above, the demand for ice will make room shortly for a dozen more like it. These amounts are independent of all that is invested in this trade and the ice that is laid up in Philadelphia, Baltimore, Boston, and other large cities of the Union, and a little consideration will show that the ice business in the United States ranks in importance with almost any one that can be named.

In dealing with the subject on the present occasion, it is proposed to offer a few succinct remarks upon the mode of collecting and storing this commodity, arranging it on board ship for export, leaving the question of statistics to a future opportunity.

Ice houses vary in size and capacity from two to fifty thousand tuns. Allowing forty cubic feet of ice to the tun, the smaller size mentioned would require internal dimensions of one hundred feet in length, fifty feet in width, and twenty-four feet in hight to the eaves. Houses for ten to thirty thousand tuns are often built in several sections, of these, or even increased dimensions, giving one the idea of half a dozen large barns cemented together at the sides, each section having its own individual roof, reminding one of the board fences one sometimes sees, where the upper edge of the fence is sawn out into pickets, looking like saw teeth. The capacity of the houses is of course determined by the amount of business the proprietor has or anticipates. As a general thing they are entirely clear in the interior, no space being taken up by beams or ties, or anything which would interfere with the regular filling up of the whole space with ice, or anything which can possibly act as a heat conductor in the summer season.

The walls are constructed with a double row of stanchions or studs, the interior ones being perpendicular and the exterior slightly inclined, so that the space between the boarding may gradually diminish from twenty-four inches at the bottom to sixteen at the top. The boarding is put on between the inner and outer stanchions, to secure it from being burst off by the pressure of the filling, and the inner and outer shells are bound together at regular intervals by iron bolts, to prevent them from spreading from the same cause. The space thus left is filled with spent tan preferably, but sawdust may be used, or what are called short shavings. The whole is surmounted by a roof with a steep double pitch, and the building is often whitewashed, roof and all, more perfectly to reflect the rays of the sun. One *sine qua non* is, that all round the foundations the whole building shall be perfectly air tight; not, as one would at first imagine, to prevent the access of air, but to prevent the cold air at the bottom from rushing out, and giving up its place to the comparatively warm air at top, which would endanger the whole stock stored in the house. This, with the requisite doors, and hoisting and storing apparatus, may be taken as the general type of a well-constructed ice house.

Ice houses are constructed preferably entirely above ground; the underground construction having been abandoned, as a general thing, for the reason that during the summer days the earth absorbs the heat of the sun, and does not yield it up at night, so that, continually absorbing heat in this manner, it is believed that the ice wastes more rapidly by underground than above-ground stowage.

When the season has been favorable, and the ice has attained the requisite thickness—the thicker the better—the ice men proceed to work. As horse power is much employed, and as ice less than five inches in thickness will not bear the weight of a horse, in an open winter it is sometimes late before the ice cutters can commence operations. If there is loose snow upon the surface of the ice, this is removed for any desired distance by means of a scoop. A space of 66 feet square, will give 108 dozen cakes. If good, clear ice is reached, the work of marking and cutting commences. If the surface of the ice is in that granular condition known as snow ice, the ice plane is required. Previous to its use the hand plow is run along one side of the space in a straight line, to form a groove, which acts as a point of departure, and regulates the motions of all the implements subsequently employed in cutting the ice.

The preliminary groove having been made by the hand plow, the swing guide marker is brought into use, and, the guide taking the groove, the marker makes a second one parallel with it. Upon turning around at the end of the course the guide is swung over so as to take the groove last made, and on the return trip a third is made. This process is repeated until all the grooves required are made, equally distant from and parallel with each other.

The right ice having been reached, the process of cutting now commences in good earnest. The large ice plow extends the depth of the grooves already made to twelve or fourteen inches. The same operation is repeated now at right angles to the former grooves, and the cakes are ready for separation from each other.

The rows thus cut are slightly bevelled, narrower below than at the top. Before doing this, however, it is necessary to take measures to prevent the water from entering the grooves and freezing therein, thus filling them up. This is done by calking them with snow, and this is done by an instrument called the calking bar, a bar with a broad chisel like end, and so made as to enter the grooves, and drive the snow to the very bottom. The two outside rows having been sawed out, the blocks lifted upon the adjacent ice, and the grooves behind the next row of blocks having been caulked as before, a bar called the breaking bar is used, generally in pairs, to pry the blocks apart, giving double the purchase attainable with a single one. The calking process must be used behind every row of blocks to be separated, else the plow would, on one of our freezing days, prove a Sysiphæan labor, having to be repeated again and again *ad infinitum*. The blocks are now floated, through a channel cut in the ice, to the ice house, which brings us to the storing and packing.

The blocks once arrived at the house, which is, whenever it is possible, built so that the ice can be floated up to it, is then seized by a huge pair of tongs made specially for the purpose, as the cakes are heavy, weighing three or four hundred pounds apiece, and hoisted up at once where they are wanted. The ice is disposed in regular tiers, the blocks being placed as closely together as possible, though no particular pains is taken to fill up the interstices. This proceeds until the house is filled. One of the most important particulars relates to the covering over all. The material preferred before all others is the long pine shavings of the carpenters. These are cleanly, durable, and not subject to decay. are easily handled by a common pitchfork, and may be used for more than one filling of the house. The objection to hay or straw is that it is liable to decay, or becomes musty. Sawdust is disagreeable, from constantly sifting down and covering the cakes of the successive tears, as the upper ones are removed.

The houses being filled, the proprietors await the summer demand for their commodity, or else proceed at once to load up for tropical markets. The ice which is stored commences to melt at the upper tier, and here is where the greatest waste occurs. The resulting water, percolating through the interstices of the ice, reaches the lower tiers, and, finding a temperature below its freezing point, congeals again, cementing the cakes together in the lower tiers so as finally to form a solid mass, if left undisturbed for a sufficient length of time. An ice house in this city was filled, and left undisturbed for four years. During the fifth year the proprietor, finding his stock of ice running low, examined this house, and found that, by melting, the ice had lowered from twenty feet to four feet in hight, and was one solid cake. He was compelled to employ his plows, and get the ice out of it in such pieces as he could; but it carried him through the season.

In the first part of the present paper allusion has been made to the difficulties encountered in the earlier efforts to transport ice to southern and eastern markets. The first cargo was despatched by Mr. Tudor in February, 1806, to St. Pierre, Martinique. He shipped about 130 tons, and of this only five tons arrived at its destination; and this trip was attended with a loss of about $4,500. Details of the different expedients resorted to, to avoid this loss would be interesting, but the mention of one must suffice. On one occasion he purchased several large cases of flannels, and endeavored by winding the pieces in and out around the ice, to protect it from its natural enemy, a high temperature; but this expedient proved unsuccessful. At length, as ice houses were erected, and the correct principles for their construction were gradually developed, it became apparent that the same principles must obtain in preparing a ship to carry a cargo of ice, converting it, in fact, into a floating ice house; and this is the way it is now done.

The first thing is to make an even floor in the hold of the ship, by filling up the furrows, so to speak, each side of the keel, with what sailors term "dunnage," consisting of fragments of lumber or ballast of some kind. This gives a tolerably wide floor for the lower tier of ice, which (the floor, not the ice) is covered with a layer of straw or hay, and this again with a thin layer of coarse sawdust or wood turnings. This allows the water from the melting ice to trickle down, and to be removed by the pumps. But as the space at the bow and stern of the ship is necessarily narrow, and would admit of the packing of but one cake of ice in the extreme parts of it, which would be attended with great loss and waste without any compensating advantages, it has been found necessary to erect partitions, or bulkheads, across such parts of the vessel as its particular model shall render advisable, so that from half to two-thirds of all the available space in the ship shall be occupied by the cargo, equidistant between bow and stern. This done, the ship is prepared to receive her cargo.

Moored at the wharf where the ice is to be delivered, the main hatch is thrown open, and a slide or chute is constructed from the landing to the hatch. Over the hatchway a windlass is erected, the drum extending entirely across it lengthwise. To this are suspended two iron frames intended to receive the cakes of ice from the chute, in such a manner as that, while the loaded one descends, the empty one rises. As the cakes of ice come rushing down the chute, they are dexterously directed by the ice hooks in the hands of the workmen to one side or the other, so as to enter the gigs, which descend with them into the hold. As the lower tier is completed, it is packed all round the sides of the vessel with sawdust. This gives additional space for the next tier, which is wider than the first, as the sides of the vessel recede from the keel; and the tiers, increasing in width until the whole breadth of beam of the ship is attained, are successively packed as described.

In the shipping of ice immense quantities of sawdust are used, so that what the owners of saw mills used to be bothered with to get rid of, now yields them a handsome revenue. It is estimated that the ice trade of Boston alone consumes sawdust, shavings, and rice chaff to the value of $30,000 a year, an item which used to be thrown away.

To deliver a cargo of ice to India involves a voyage of sixteen thousand miles, occupying four or five months, during which the equator is crossed twice; and if one half the cargo is delivered it is regarded as a success. The loss, is, however, sometimes much greater, even amounting to 75 per cent. On shorter voyages, such as the West Indies, and the southern part of the United States, the loss will not often exceed 33 per cent of the amount shipped.

It would seem that ice, costing nothing for the raw material, might be furnished at lower rates than is demanded for it; but when the amount of capital and labor employed, in houses, men, teams, horses, tools, and machinery are taken into the account, together with the greatly advanced cost of every item which enters into the business, it will be at once seen that only the utmost care and the most perfect appliances can render operations remunerative enough to induce capitalists to invest their funds, and allow them to continue thus appropriated.—*Journal of Pharmacy.*

A 6000-pounder Gun.

One of our most successful inventors and engineers has lately patented, and the specification has been published, of an enormous air-gun of 32-inch bore, to throw a 6000 lbs. shot. The bore of the gun is to be upwards of 30 feet long, and the inventor asserts that he can compress and retain air at a working pressure of 10,000 lbs. per square inch. The sectional area of a 32-inch bore is $804\frac{1}{4}$ square inches, and the total initial pressure would thus be 8,042,400 lbs., or nearly 3,600 tuns. It would, of course, be next to impossible to pump in air fast enough at this enormous pressure to keep up the velocity of the shot, so the high pressure air is to be contained in a huge casing or jacket formed around the bore of the gun, and having the same capacity of say 165 cubic feet. Thus, instead of the pressure being reduced almost to *nil* at the muzzle, the air would have been expanded but two-fold on the discharge of the shot; and if we disregard the influence of rarefaction, and consequent cooling by expansion, and its effect on the pressure, we should have 5,000 lbs. per square inch still left. If we take the average pressure at 7,500 lbs. throughout the length of the bore, we shall have 2,400 tuns exerted through 30 feet, or say 72,000-foot tuns, and this, were the air to follow fast enough, would send a 6,000-lb. shot at a rate of more than 1300 feet per second. As no ordinary valve could be opened quickly enough to admit air under such pressure, and in such quantities, the shot itself forms the valve. The high-pressure air in the air casing or jacket enters the chamber of the gun through ports, like those by which steam enters a steam cylinder. The shot—a short cylinder with hemispherical or pointed ends—is so packed as to close these ports while the jacket is being pumped full. To discharge the gun a little high pressure air is separately pumped in behind the shot, so as to start it on and past the ports, when the stored-up air does the rest of the work.

Although there may be certain practical difficulties in carrying out this scheme, it possesses great interest, and we shall look with much curiosity to its practical realization.—*Engineering.*

To Coat Iron with Copper or Brass.

The copper or other coating is to be melted in a suitable vessel, and a stratum of borosilicate of lead placed on its surface: the iron is then to be plunged into the molten metal, and retained there until a coating is deposited on it. Iron coated with the tin or lead may be treated in a similar manner. Another method of coating iron with copper is to place in a crucible a quantity of chloride of copper, upon which is laid the iron to be coated, and over that a quantity of charcoal. The crucible is then submitted to a red heat and the chloride of copper fused, and a coating of copper deposited on the iron; or the vapor of chloride of copper may be employed for the same purpose. The coating of copper thus obtained, may be converted to one of brass by exposing the sheet of metal to the vapor of zinc in a closed vessel.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

The Giffard Injector.

MESSRS. EDITORS:—In your paper of the 2d of May, you intimate that the principle of the Giffard Injector is not well understood, and present your readers with an explanation, given by Mr. John Robinson, of Manchester, Eng., as the best elucidation of the puzzle. I am of the opinion that Mr. Robinson himself does not show a very clear perception of the thing. At any rate, he fails to make it plain to any ordinary comprehension. With your permission, I will endeavor to do so myself.

The operation of the Giffard Injector is dependent on the laws both of pneumatics and hydrodynamics, and its secret lies in the fact that under any given pressure aeriform bodies are propelled with a very much greater velocity than liquids. Thus, if we would communicate to water a velocity far above any thing that could be accomplished by hydraulic machinery, let us first convert it into steam, then set it in motion and suddenly reconvert it into water by condensation; the water will retain the velocity of the steam.

To illustrate by example: We have a steam boiler in operation, under 90 lbs. pressure. If we run a pipe from the steam chamber into the boiler, under or above the water level, equilibrium will exist. But if we open the pipe into the air, steam will flow in a jet. I have no means at hand to ascertain the velocity of a jet of steam under 90 lbs. pressure—about 6 atmospheres—but a table before me gives the velocity under one atmosphere at 650 ft., increasing in a constantly diminishing ratio to 1,600 ft. under 20 atmospheres. Perhaps under 90 lbs. a velocity of 1,000 ft. would be a fair estimate. At any rate, I will assume it for the purpose of this illustration.

Suppose now that the steampipe is of just such length and caliber as to contain, under 90 lbs. pressure, the product, in steam, of one cubic inch of water. Remember it is moving 1,000 ft. per second. Suppose again, that it is suddenly and perfectly condensed, and we have a cubic inch of water flowing with a velocity of 1,000 ft. per second. Now if we open an orifice in the boiler below the water level, a jet of water will be projected from it with a velocity of about 114 ft., which is due to a pressure of 90 lbs. If, again, by means of outside machinery, we throw a jet of water of the same diameter with the orifice, and directed at it, with a velocity of 114 ft., there will evidently be equilibrium; because, as pressure and velocity are convertible into each other, the force of the jet will exactly counterpoise the jet seeking to flow from the orifice, and no water will pass into or out of the boiler. But if the jet, by additional pressure, attain a velocity of 115 ft., then the equilibrium is destroyed, and water will pass into the boiler through the orifice.

To recur now to the cubic inch of water in the steampipe, with its velocity of 1,000 ft. per second. How much more easily and rapidly will it penetrate, where even a velocity of 115 ft. is sufficient to overcome the resistance. And suppose, now, that it comes in contact with another cubic inch of water in a state of rest. It will part with half its velocity to the latter, and both commingled, will move on at the rate of 500 ft. Let these two come in contact with other two at rest, and again, the weight being doubled and the velocity halved, they will move 250 ft. per second. Still again, let these four strike four others in a state of rest, and we shall have eight cubic inches moving with a velocity of 125 ft. per second, which, as we have seen, is sufficient to effect an easy and rapid penetration into the boiler. Of these eight, one is the cubic inch that was condensed out of the steam in the pipe, and here we behold it commingling with and carrying along seven others, by which, in fact, it was condensed, with a velocity much greater than that of a jet projected from below the water level of the boiler under the existing hydraulic pressure of 90 lbs.

I have taken for illustration a given amount of steam and water. In fact, however, there is a constant flow of steam, a constant condensation by an uninterrupted stream of water, and an unbroken jet into the boiler.

It may be asked, if the steam jet itself were directed at an orifice in the boiler, would it penetrate? It would not. It must be remembered that force is a product of weight and velocity, and here the weight of steam being so insignificant —it requiring 1,700 cubic inches under the pressure of one atmosphere to weigh as much as one cubic inch of water—the force would be insufficient to penetrate. But it is a very different thing when water moves with so great a velocity.

The principle of the Giffard Injector is applicable to other purposes than feeding boilers. It makes a good pump for shallow reservoirs. It would make a very powerful fire engine. It could be used to drive light machinery, by throwing its jet into a turbine wheel running at a high speed. I have used it to propel a toy boat—not very satisfactorily, however —having a small copper boiler heated by a spirit lamp, and throwing its jet back under the stern.

Nothing has been said, in this discussion, of the construction of the apparatus, nor was it necessary, as I presume that is familiar to all engineers. I have aimed only to develop the principle. It is a very beautiful invention.

Tuscaloosa, Ala. H. S. WHITFIELD.

Size and Capacity of Millstones.

MESSRS. EDITORS:—J. W. H., of Minn., on page 39, current volume, asks if it will take any more power to grind eight bushels of wheat in the same time on a four-feet run of stones than one of three feet. A very practical question, and one that all millers ought to be interested in, as it touches the absorption of power in all mills.

"H. M.," of Minn., page 263, attempts an answer, but gives no proofs. He says; "I think it will take less power to do the work on the four feet stone, as the velocity required to make the smaller stone equal in capacity the larger absorbs a large proportion of the power." If H. M. means that the larger stones absorb a large proportion of the power to do the work given, I agree with him; but if he claims that it is necessary to run a three-feet stone to equal in area of feet a four-feet stone to grind the given amount, then I beg to differ. Example: The usual motion given to a four-feet stone is 180 revolutions per minute, and some run them to 200 revolutions per minute, but I have stated the minimum. Now let us see what figures tell us about the frictional surface or area of face of a 4-feet stone running at 180 revolutions per minute. Area of stone, 1,809·56 inches multiplied by the velocity and divided by 144, equals the area in feet per minute—a trifle over 2,261·94 feet. A 4-feet stone at that motion, with proper power applied, is able to grind 16 to 18 bushels of wheat per hour and do its work well, and many even greatly exceed that amount if their burrs are heavy.

Some millers might ask: "What is the use of running the stones so fast if they will grind 16 to 18 bushels per hour when we only want to grind 8 bushels?" I answer, because experience says that is about the proper motion for a 4-feet stone to run at to discharge the flour and meal properly, the draft in furrow being one inch to the foot.

Now let us see the capacity and friction of a 3-feet stone running at 240 revolutions per minute. The peripheries of the 3 and 4-feet stones would travel at the same rate, but their areas differ greatly. The area of a 3-feet stone is 1,017·87 inches, multiplied by the velocity and divided by 144, equals 1,696·44 feet per minute, a difference in favor of small stones of 565·50 feet per minute. Experience proves that a 3-feet run of burrs, at the above motion and proper power applied, is capable of grinding 10 to 12 bushels of wheat per hour, and do its work well.

Again, if you would grind 16 to 18 bushels per hour on a 3-feet run of stones, it would be necessary to run them to 320 revolutions per minute. Then they would be equal to a 4-feet run, if they are heavy enough; but as a general rule it is impossible to run at that motion, on account of the grain choking in the eye of the stone. Therefore to grind 16 to 18 bushels per hour with one run, the 4-feet run at 180 revolutions is preferable on that account.

A 3-feet burr running at 220 revolutions, with proper power applied, is capable of grinding 8 to 10 bushels of wheat per hour and do its work well; if that is the case, then let us see where we have saved power. The area of a 4-feet stone running at 180 revolutions is 2,261·94 feet per minute; the area of a 3-feet stone at 220 is 1,555·07; difference in favor of small stones of 706 87 feet per minute. What are these extra feet unless rubbing surfaces?—friction. These extra feet cost more in the first place, have to be kept in order, take longer to dress, absorb power, and generate heat, a great detriment to good grinding.

If I have proved that the 3-feet burrs will grind the stated amount (8 bushels), then throw the 4 feet out and save power; if your power is light it will pay. I have one run of 3-feet burs running in my mills at 220 revolutions; it grinds 8 to 10 bushels of wheat per hour, and does its work as well as a larger stone, and saves power. At one time I thought a 4-feet burr just the thing for any power or amount, but experience has taught me differently. Now I use the size of stones and number of runs best adapted to the work and power.

In erecting new and overhauling old mills, the first thing in order is to ascertain the amount of power you have at command; then you can determine the size and number of runs you can use. The next thing in order will be the cleaning and bolting apparatus, ever remembering to have enough. GEO. RULE.

Wheatland, Iowa.

The Moon As an Inhabited Planet.

MESSRS. EDITORS:—On page 280, current volume of the SCIENTIFIC AMERICAN, you have an article under the heading "Lunar Vegetation," which is good as far as it goes, for it verifies to a certain extent the writings of a philosopher who lived nearly one hundred years ago, namely, Swedenborg. He claims that the moon and all the planets are inhabited, and meets the objection "that the atmosphere surrounding the moon is too light to support man," by the answer, "that things are created for their conditions," and that the men of the moon have lungs constructed for their especial needs.

By referring to Swedenborg's work on the "Planetary System," you will gather my meaning as I may not have been explicit enough. A. W. W.

New York.

GENERATING STEAM BY GAS.—Illuminating gas has been employed in England, in heating steam boilers and generating steam for working the hoisting apparatus of warehouses, or other purposes where steam power is only required at intervals of time. With a vertical tubular boiler of three horse power, steam at 60 pounds pressure is generated by twenty-three burners, consuming 100 feet per horse power per hour in full work. The compactness, economy, and efficiency of the gas heated boilers is highly recommended by those who have used them. The first cost and expense of maintenance is small, and the insurance companies have decided to require no heavy risk premiums on buildings furnished with boilers heated by this plan.