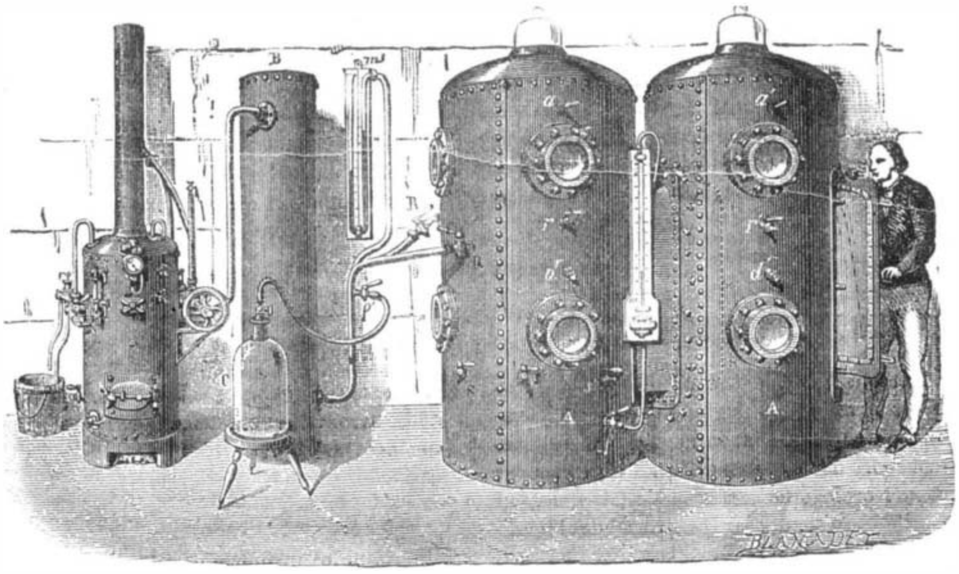
EFFECTS OF AIR PRESSURE ON ANIMAL LIFE.

A series of brilliant and remarkable experiments have recently been conducted in France by M. P. Bert, having for their object the determination of the influence of changes in barometric pressure, either augmentations or diminutions, upon animals. The author, in submitting the results of his investigation, states that both men and inferior animals which live on elevated land are submitted to a pressure the weakness of which, in proportion to that at the sea level, cannot be without its effect upon their organizations. Important cities, in fact, exist at altitudes above 9,600 feet, and the high plateaus of Anahuac, Mexico, are populated by thousands. There are, besides, industrial pursuits which require workmen to labor in a strongly compressed atmosphere in submerged caissons, as are employed in bridge building, in the operation of sinking wells, in the descent of diving bells, and in pearl, coral, and sponge fishing.



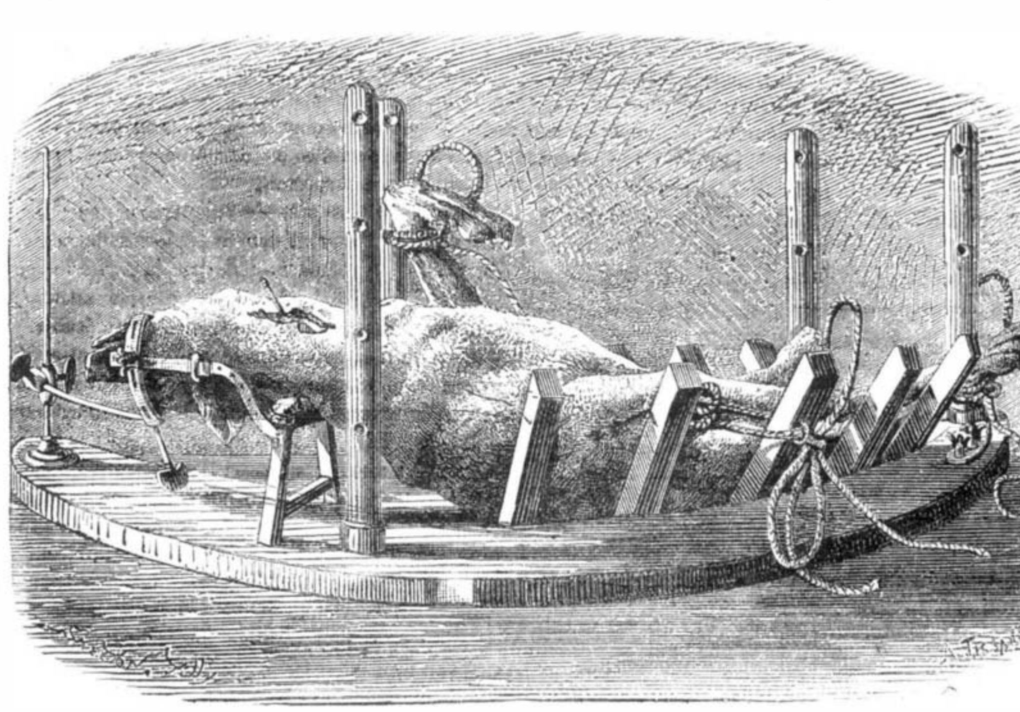
BERT'S APPARATUS FOR NOTING EFFECTS OF AIR PRESSURE.

In describing the discoveries of M. Bert, to the experimental demonstration of which we shall shortly pass, it is necessary first to remind the reader that the actual tension of the oxygen in the air which we breathe is equal to one fifth that of the atmosphere, since the gas constitutes 0·21 of the composition of the latter. Now this tension may be increased by compressing the air, so that air containing 42 per cent of oxygen will correspond to ordinary air at two atmospheres pressure, and so on, relatively, upwards. Inversely the tension of a semi atmosphere, equal to 14·8 inches of mercury, will be 10 5; of one third atmosphere, 7, and thus down.

The researches of M. Bert show that the atmospheric pressure never acts by any mechanical or physical influence, as has been heretofore supposed, but solely by causing the tension of the oxygen to vary, and hence the conditions of the combinations of that gas with animal blood and tissues. When the pressure decreases, animals and vegetables are menaced with death by simple suffocation, due to a privation of oxygen. When the opposite state of affairs occurs, death likewise supervenes, due to the poisonous effect of the excess of oxygen.

In the following description, the experiments upon the results of diminution of pressure are detailed, and in a succeeding article we shall notice the investigations bearing upon the effects of opposite conditions. In order to experiment upon large animals, M. Bert, constructed the apparatus represented in Fig. 1. A A' are large cylinders containing heavy glass windows. B is another cylinder, in which a vacuum is formed. C is a bell glass in which, by means of B, a vacuum may be instantly produced. R R' are cocks communicating with the cylinders; *r*, *d*, and *s* are other cocks for removing blood, etc. At *a a'* are the thermometers, and at *m m'*, manometers. The boiler shown at the left operates a steam air pump, which, in connection with the apparatus, produces low pressures of air in the cylinders.

In order to determine the gases in the blood, a dog was fixed on a sort of semi-circular frame (Fig. 2), which fitted exactly into one of the cylinders. The carotid artery being exposed, a tube was conducted therefrom and carried to the exterior of the cylinder. By suitable devices the blood could be drawn at any moment without causing coagulation or allowing the surrounding atmosphere to enter the artery. The drawing was done by the operator outside, by means of a graduated syringe, and the gases were removed from the fluid by a peculiar pump.



MODE OF PLACING ANIMALS IN BERT'S AIR CYLINDER.

From numerous analyses thus conducted, it appeared that below a pressure of 21·4 inches there was an increasing diminution of the oxygen in the blood. From 20 volumes of oxygen to 100 volumes of blood at the above barometric hight, the decrease proceeded as follows: 17·5 inches, 16 volumes; 13·6 inches, 12 volumes; 9·7 inches, 10 volumes; 6·4 inches, 7 volumes. In other words, below 11·7 inches the arterial blood is poorer in oxygen than ordinary venous blood.

A very striking experiment showed clearly that the suffocating effects were due to the preponderating influence of the tension of the oxygen and not to the almost null results of barometric pressure. A sparrow was placed under a bell glass, in which a gradual depression was produced. The bird appeared very ill at 9·7 inches, and fell apparently dying at 7·8 inches. Normal pressure was then re-established by admitting oxygen. The bird recovering, further depression was proceeded with, when the same effects did not take place until from 7·02 to 5·8 inches. Oxygen again admitted caused a second revival, and, finally, it was shown that the diminution might be carried to 2·7 inches without killing the animal.

Not content with thus proving the truth of his theories upon lower animals, M. Bert, in order to determine the sensations experienced, entered the cylinder himself. At a pressure of 17·5 inches, he experienced the sickness known as *mal de montagne* accompanied by nausea and weakness, the pulse increasing from 60 to 85 beats. At this moment he admitted and breathed an artificial atmosphere containing 75 per cent of oxygen. Instantaneously the illness disappeared, and the pulse returned to its normal condition. The investigator remained in the cylinder without inconvenience when the barometer marked 9·7 inches. This corresponds to a hight of 28,320 feet, a point above that at which Glaisher, in his celebrated ascent, fell senseless, and equal in altitude to the highest mountain peak on the earth.

It would appear, therefore, that, through M. Bert's discoveries, explorers will be enabled to ascend elevations hitherto deemed inaccessible, and aeronauts to penetrate regions of our atmosphere where life, under ordinary conditions, cannot exist.

European Ordnance.

The United States Government, being in quest of a system of rifled ordnance, sent a naval mission to Europe four years ago to inspect the chief gun factories in the principal countries in Europe, and to report upon the systems of ordnance in course of manufacture. This has resulted in two quarto volumes, containing 640 pages of matter, the best half of which is devoted to the ordnance produced in Great Britain and the remainder to the Continent. Considerable discrimination has been shown in selecting salient points for detail, and much impartiality in describing the merits of the various systems, both of construction and of rifling, etc. Admitted to the principal factories of Europe, the American naval mission made good use of eyes and ears, and the result is a compilation of varied information which only needs an index—strange omission—to prove of great service both to the manufacturer and to the artillerist.

Amongst the factories visited in England: Woolwich, the London Ordnance Works, Whitworth's, Jarrow, Barrow-in-Furness, and Low Moor are duly honored, the system of construction at the Royal Arsenal and by Messrs. Vavasseur being carefully detailed; while the treatment of the ore at Jarrow and Low Moor, etc., is carefully described, as well as the production of steel by Firth and by Whitworth. Our gunpowder factories, dockyards, iron plate rolling, torpedoes, and naval organization are not forgotten. Our own naval men may learn from their United States brethren some important facts connected with their own weapons, which have hitherto been shut up in the archives of the War Department. It is, however, when the naval mission passes to foreign ordnance factories that interest is chiefly awakened, Little is known in this country of foreign ordnance, except that nearly every country in Europe has obtained Woolwich guns and projectiles for experimental comparison with their own, and they one and all have rejected both the construction and the rifling in favor among English soldiers. Holland does, it is true, import Armstrong (Woolwich) guns and projectiles for its few ships of war; but its army adopts the French breech loader. For a time the Austrian naval armament was divided between Krupp's breech loaders and Armstrong's (Woolwich) muzzle loaders, but the short life of the latter has led to its being discarded. France, which has fallen behind the race of ordnance construction, gave the Woolwich system a patient and exhaustive trial, with the like result. Italy is striving manfully to work out a system of its own. Russia and Germany have given themselves over unreservedly to the Krupp system.

All heavy ordnance are now built with steel barrels, this material being found best capable of withstanding erosion from the powder and indentation by the shot. But much divergency occurs in the mode of supporting the barrel by exterior layers of metal. Woolwich obtains support by coiling, round the steel barrel, bars of wrought iron. Vavasseur supports the barrel by shrinking on hoops of steel, so regulated that the first layer of hoops shall not come into serious operation until the elasticity of the barrel has been developed. Krupp, who has been gradually assimilating his construction to that of Vavasseur, first by abandoning block steel for the breech, and then abandoning it for the chase, still makes the barrel much thicker at the inner end than is found desirable in this country, and so shrinks on the outer hoops as to cripple the elastic action of the barrel. The French have adopted a system of construction which would be tolerable enough in conversion of old cast iron guns into rifled ordnance of an inferior order, but is without any merit but cheapness in new pieces. A steel half barrel is imbedded in cast iron, and further supported by steel hoops over the powder chamber. By this means the elasticity of the steel half of the barrel is crushed, and a joint with cast iron formed in the interior. The idea was, probably, taken from Parsons' system of converting old smooth-bore cast iron guns into rifled ordnance, which was tried in France with most marked success. But if so, we can hardly think the new plan an improvement on Parsons' method of inserting a full length steel barrel into the old cast iron bore, and supporting the powder chamber by steel jackets in contact with the barrel.

The Palliser conversion differs from the Parsons, chiefly in employing a barrel of wrought iron, a material too soft to endure large charges or the hammering of loose heavy projectiles. But the strangest system of converting cast iron smooth bores into rifled ordnance is that adopted in Holland, of lining the bore with bronze, a soft material quite incapable of withstanding the heat and rush of gases evolved in the combustion of large charges.

Belgium employs a cast iron barrel, supported, from breech to trunnions, by two tiers of steel rings or hoops. But as this country has no navy, it does not require very heavy ordnance, and its experience in this direction is not so great.

Next to the material and system of construction, the question of breech *versus* muzzle loader demands attention. Recent experiments have shown that an enlarged powder chamber, in permitting a reduction in length of the cartridge and thus placing all the powder more nearly equidistant to the point of ignition, improves the combustion, and adds largely to the velocity and striking force of the projectile. This enlargement of the diameter of the cartridge beyond that of the bore can only be attained by breech loading. The plan of closing the breech originally adopted in this country, having proved very faulty, the principle was discredited, and the system abandoned. But wherever the naval mission of the United States went on the Continent, they found breech loading in favor, so that of all the considerable States of Europe, England, stands alone in its use of muzzle loaders.

The difficulty of preventing the escape of gas at the breech naturally increases with the amount of gunpowder and weight of shot employed. But it would appear that the Broadwell ring [an American invention], now generally in use with the heavier breech loaders on the Continent, and in a modified form used by Vavasseur in this country, appears effectual to that end. Krupp's breech closing arrangement is free from all the objections which led to our discarding the Armstrong system, and deserves the commendation given it by the naval mission.

The real difficulty in ordnance lies, however, in the projectile. To contrive a projectile which can be driven most rapidly out of the gun, without wriggling in the bore, with its center coincident with the axis of the piece, and with the minimum of strain upon itself and the gun, while receiving the impress of a rotation proportionate to its length, has exercised many minds. Though the lead-coated projectile of Krupp has many excellences, high velocity or great penetration cannot be amongst the number, inasmuch as the drag through the barrel resists high speed, and the peeling off the lead coat in passing through armor impedes perforation. Vavasseur's copper-ringed projectile would compare favorably in both these aspects. And either would ensure a far steadier passage through the barrel, and therefore more equable powder pressures, than the balancing studs of Woolwich. France appears to have adopted copper rings on the projectiles for its new breech loaders. Objection may be taken to the overhang, unsupported at either end of these shot; but as the ring bites the grooves above as well as below, there is none of that balancing movement which is present wherever a windage shot touches the bore only at the two studs beneath and is free all round its body. If the long iron bearing and centering devices, employed in muzzle loaders by Vavasseur, Scott, Lancaster, and Whitworth, could be efficiently employed in breech loaders, we should expect higher velocities and better penetration than from any compression system of rifling. The difficulty is not insurmountable of preventing these windaged projectiles overshooting their seat when loading from the breech. Whitworth has breech loaders on his system, but of small caliber, where the difficulties are small, and we can hardly accept this evidence as alone decisive in favor of the employment of windaged shot in breech loading ordnance.

The dispassionate tone adopted by the naval mission of the United States in describing the ordnance of Europe lends weight to their impartial descriptions and very reasonable recommendations; so that, whether we adopt their conclusions or not, we cannot but listen respectfully to their suggestions. The sum of their recommendations is that the Vavasseur system of construction is the best in Europe; the Parsons system of conversion, most suitable for old guns. Breech loading cannon being universal except in England, the breech closing arrangement of Krupp, with the Broadwell ring for "gas check," is regarded as best for adoption, while projectiles should have the copper rings of Vavasseur.

The Woolwich system is honored in being made the standard of comparison with that of the civilized world, with the result, however, of being declared inferior to the Vavasseur and Krupp; and the concluding paragraph of this extensive report is reserved for a condemnation of the studded projectile in favor at Woolwich, which is the chief offending cause that has landed us in such artillery difficulties that Rear Admiral Sherard Osborn, C. B., F. R. S., says: "I, for one, do not desire to take any share of responsibility in the great gun *fiasco*, which, I fear, awaits us on the commencement of a war with a first class naval power."—*Iron.*

The Education of Artisans.

Since the application of steam as a motive power for the production of almost every commodity required by man, everything seems to be wanted in a hurry; and for smart, intelligent workman of every craft, a continually increasing demand is plainly observable. But in nearly every calling thoroughness has been hitherto sacrificed to the impatience of customers, and we seem to become the more pressing the quicker we are served. The consequence is that the mechanical arts are cut up into branches, and the artisan, who should know all about his business, is made a mere expert at one particular part. Whatever a workman is quickest at like a machine, that he is kept to; and as long as he earns a living by that one thing, it is ten to one if he ever seeks to know any more. Were he compelled to turn his hand to other parts of his business, he would have to occupy in a useful way, in order to qualify himself for the performance of task by which he earned much brain work, he is the more easily led into idle pastimes, in which he often indulges to excess. His comparative prosperity makes him consequential. If he were made his daily bread. But this being secured to him without to feel that on the completeness of his abilities depended the bread which he is in the habit of earning by the repetition of a mere mechanical performance, which through constant practice becomes of no trouble to him, his mind would receive a new stimulant with each different job, and study would be the result.

Being thus compelled to see for information, his mind would be led into the parts of true knowledge in the search, and, once fairly started on that road, he would not be long until he could discern sound argument from bombast. There is much talk at present about technical education; but before the attainment of it will bear any fruit, the system of parceling out must be changed. When a boy is apprenticed to the tailoring trade, if he proves any way smart at making a vest, he never will get the chance of making trousers; and if he be quick at the latter, he will never be asked to put a stitch in a coat. What is the use of teaching the theory of any trade in schools with such a practice in existence?

In the building trade, we have masons or stonecutters who are not expected to set the stone they have wrought; wallers who turn no arches; bricklayers who dress or set no stones; and hundreds who could not read a drawing or get out a mold by which to work. Among those who are called joiners, we have men who make sashes they could not hang, and who never saw a "mouse" in their lives. We have "fixers" who, as a rule, make nothing they put up; and "framers" who would not be able to perceive the same angle in two different positions. We have "staircase hands" who affect to despise everything else connected with the construction of a building, and who, as a rule, look upon themselves as gods of wood, although they never made a circular headed sash in the whole course of their existence. Well planned houses suffer in their erection through this practice; for the "bench hand," who has been kept for a number of years at what he can do quickest, is often necessitated to turn in with a crowd of "fixers" and scrape away as best he can.

Considering the present system, it would appear that, with most builders, profit alone is the *alpha* and *omega* of every undertaking. It looks as if they do not care whether a house stands or falls, after it has been built and their gains counted into the bank. Very few have any considerations for the welfare of those whom they employ; and consequently, there is little or no reciprocation. The workshop, which ought to be conducted on the principle of a school where technical instruction is imparted, as well as for the fabrication of an article which brings a profit, is very often superintended by a man chosen more for his driving qualities than for his information.

It is seldom that a man capable of imparting what he knows is met with in such positions, and the generality of men in charge are cross and intemperate in their language, instead of being kind and considerate. As to receiving instruction, men are left very much to themselves to pick up that which they would sooner and better understand if explained by a man competent to do so. The language used by the generality of foremen, too, is very often the most abusive and sometimes revolting, such as no man aspiring to a respectable position in society should be heard giving utterance to. The susceptible dull youth of one-and-twenty is sneered at if he chance to ask the foreman a question concerning his work, and mulcted out of money, or wheeled into paying for beer, for the information which he receives from his older fellow. Capitalists should look after these practices, and apply a remedy, for one or two hours' prefatory instruction or forethought often saves a great amount of labor. Those who cannot see before them lose much time groping their way, and obviously the loss is to the employer. It is often said that the workers are not expected to be thinkers. In fact, the remark is frequently made: "You are paid for working, sir, not for thinking," addressed as a reprimand to those who gave such a reason for being caught, as the man in charge might suppose, wasting the employer's time. This is, too, without the least inquiry concerning the truth of the assertion. The result of this system is that men who would otherwise seek to become intelligent and useful in a general sense, lay down their minds to become expert at one or two things, and in many cases sharp only at what is called "shaping," that is, by their bustling about and wielding their tools juggler fashion, making people believe they are qualified for anything. To be sure, this kind of tact shows a knowledge of human nature on the part of the person who employs it, and the present system is the chief cause that leads many to resort to it; but also shows the weakness, superficiality, perhaps vanity, of those who are the victims.

If it were the practice that the foreman was bound to call his apprentices and men together once or twice a week, say for an hour, or even half an hour, at a time, and give them a lecture during working hours upon some technical subject, hundreds would be very thankful, and willing to subscribe to the expense. After working hours, very many working men do not like attending lecture halls for such a purpose, and they would be more at home in a class got up specially for themselves, and particularly when it would be taught where every practical appliance necessary for demonstration was close at hand.—*The American Builder.*

Correspondence.

Horse vs. Steam Power.

To the Editor of the Scientific American:

I see that, on page 346 of your current volume, W. F. W. asks which is most efficient, a two horse steam engine or two horses weighing 2,000 lbs., when used in an endless railway power. The answer to this query states that usually an engine of one horse power will do more work in the same time than one horse could do, with the advantage that the engine would not get tired.

I desire to state that, from numerous statistics from English and French authorities for a century past, together with over thirty years' experience in the application and use of animal power as a substitute for manual labor, and numerous and exhaustive trials with all motors, especially horses and steam power, I am satisfied beyond a possibility of doubt that any two good work horses, of two thousand pounds weight, can walk eight hours each day at the rate of about 1¼ miles per hour upon a moving plane at an inclination of from 13° to 15°, without fatigue or injury, for six days per week for their natural working life; and this, upon a well designed and constructed endless railway power, will cause them to exert an average constant power equal to about 82,500 foot pounds per minute, or equal to 2½ horse power; from which must be deducted for friction of such power (by actual results) from 11 to 15 per cent, which reduces the force transmitted and utilized to, say, 77,550 foot pounds per minute, or 38,775 foot pounds per minute for each horse, or 1·175 horse power net, transmitted. These data are partially taken from the reports of trials by the United States Agricultural Society and the New York State Agricultural Society during the past ten years.

In regard to small steam engines, I have always allowed and deducted (for their own friction) 25, 30, 35 or 50 per cent from their rated power for six, four, two, and one horse steam engines respectively; and a long experience has confirmed in my mind the correctness of this reduction. With poorly designed and poorly constructed horse powers or steam engines, the results would be lessened, while almost invariably the expenses of operating them would be enhanced in a like ratio.

Albany, N. Y. HORACE L. EMERY.

The Mississippi River.

To the Editor of the Scientific American:

Having noticed within the past year a number of schemes to relieve the shipping of the bar at the mouth of the Mississippi river, I intend to bring before the government a plan for carrying vessels, not over but through the bar, in the following manner: I would build a propeller to draw as much water as the largest ship that will be required to be towed through the bar. She should be as short as possible, in order to be easily manipulated and not require too much ballast to get the required draft. In or near the bottom of her hold, I would place a sufficient number of immense force pumps, to be worked by steam. I would have five iron discharge pipes, of nine inches diameter, to discharge their water through the steamer's cutwater, one above the other, well down below the mud line. The two lowest pipes are to point slightly down in order that the water will pass under the boat when she is in motion. The pipes are to come flush with the outside of the boat and to be reduced to a diameter of six inches at the point of discharge, to give the water velocity. Then I would have three seven inch discharge pipes, contracted to five inches at the mouth, on each bow, one above the other, well down under the boat and pointing down and forward at an angle of 30°. Then I would have a row of seven inch discharge pipes about 10 or perhaps 15 feet apart, along the whole length of the boat on each side, well down under her sides and pointing down and forward at an angle of 30°. Those pipes are to be contracted at the mouth to five inches diameter. I propose also one six inch pipe to discharge its water down through or alongside the keel, well forward under the bow. The feed or suction pipes are to take the water as near the surface as possible, in order to use clear water.

I believe such a boat would tow any ship or steamer through the bar at the mouth of the Mississippi river with perfect ease and safety. She would have a perfect volcano under her, constantly bursting up through the mud and sand and leaving behind her an immense channel. And as she would be constantly tearing the bar to pieces, the ebb and flow of the river would in a great measure remove the bar altogether. I think there is no plan by which the obstructions can be so cheaply overcome, as one such boat will do all the towing both in and out of the river.

A powerful force pump put on board of the steamers running above New Orleans, to throw a powerful stream or two under their bows, would be a great assistance to them in getting off sand bars, where they often get stuck fast.

Presque Isle, Mich. SIDNEY COOK.

Prices of Gas.

The following are the current rates for gas paid by consumers, per 1,000 feet:

Albany	$2.50	Rochester	$3.50
Baltimore	$2.75	St. Louis	$3.25
Boston	$2.50	Syracuse	$3.25
Chicago	$3.37½	Troy	$3.25
Cleveland	$2 50	Washington	$3.56
Concord	$3.20	Hamilton	$3.00
Harlem	$3.00	Kingston	$3.50
Lowell	$2.75	London, Canada	$3.00
Manchester	$2.70	Montreal	$2.60
New York	$2.75	Quebec	$2.80
New Orleans	$3.00	Toronto	$2.50
Oswego	$3.50		

A writer in the Boston *Cultivator* finds that most of the so-called strained honey sold in bottles is composed as follows: Cane or other sugar is melted in a decoction of slippery elm bark in water. Some manufacturers use, instead of elm, a solution of gum arabic and starch, to give it consistency and save sugar; but this last does not resemble honey so much when dropped, as it lacks the stringy appearance. These mixtures, with or without the addition of a little cheap Cuban honey, are flavored with essence, and the mess is ready for sale. The only true way to obtain real honey is to buy it with the comb.

TO DESTROY MOLES.—Bryan Tyson, Washington City, gives the following method for making pills to destroy moles: Make a stiff dough of corn meal, mixing with it a small quantity of arsenic. Make a hole with a finger in the runways, drop in a lump of dough about the size of a marble, and then cover over with a lump of earth to exclude the light. After the first rain, go over the field again and deposit in all freshly made roads. I once concluded to plant a piece of sandy bottom land in sweet potatoes; but as it was much infested by moles, my success depended on first exterminating them. A few doses of arsenic given in the way described brought about the desired result, and it was a very rare circumstance to see the track of a mole in this piece of ground during the entire summer.

CHARGES FOR MACHINE TOOLS A QUARTER OF A CENTURY AGO.—The following is interesting as showing the cost of work done on machine tools twenty-five years ago. We give the charge per day for use of tools: Large boring mill, $17.50; medium boring mill, $12; large punching machine, $25; heavy lathe, $15; small lathe, $5 50; large drill, $8; medium drill, $4.50; large planer, $7.37½; medium size planer, $5.33⅓; forge (with smith and helper), $10; small forge (with smith and helper), $5. Machinists received from $1.95 to $2.15, and boiler makers, from $1.75 to $1.90.