Correspondence.

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

A Wonderful Turbine.

MESSRS. EDITORS:—On page 258, No. 17, current volume of SCIENTIFIC AMERICAN, you publish a communication from F. Wilber, on "Turbines and Water Power," who asks your opinion, or that of some of your readers, as to the possibility of a six inch turbine doing more work than two twenty feet overshots, as stated by parties using a "Leffel Turbine," in an advertisement to which he refers; in reply, allow me to say that the power of a turbine does not depend necessarily upon the diameter, but upon the quantity of water which it discharges, and which is commonly denominated "square inches of discharge," and which means the quantity of water which will flow through an opening of the given area, under the given head, without "contraction."

It is stated that one set of cards, one jack of one hundred and eighty-four spindles, two looms, etc., are driven by a Leffel turbine, under forty feet head, with three-fourths of a square inch of water. Now a vein of water of three-fourths of a square inch cross section, discharging under forty feet head, will give theoretically 1 2-10 horse power. The best turbines usually develop about eighty per cent. of the theoretical powers of a given quantity of water. Eighty per cent. of 1 2-10 horse power gives 96-100 horse power to do the amount of work stated, but which actually requires not less than four horse power. It is also stated that this wheel does double the amount of work that could be done with two twenty feet overshots, which were as good as were ever built; consequently they must have given seventy-five per cent. Therefore this turbine must have developed one hundred and fifty per cent. of the power expended. Again, eighty-four gallons of water per minute are stated by the parties to be furnished by their stream. A gallon of water weighs $8\frac{339}{1000}$ pounds, from which we have $\frac{84\times8\frac{338}{1000}\times40 \text{ ft. head}}{33{,}000}=\frac{848}{1000}$ H. P. theoretical effect, 80 per cent of $\frac{848}{1000}$ H. P. is $\frac{678}{1000}$ H. P. to do the work stated. These, Messrs. Editors, are the facts of the case from which your correspondent and the public will see that this wheel, according to figures which "cannot lie," is developing from one-and-a-half times to more than three times the amount of power there is in the water itself. A most remarkable achievement and worthy the attention of all desiring great economy of water! CHAS. E. FOWLER.

Carmel, N. Y.

Prevention of the Musketo Pest.

MESSRS. EDITORS:—In a recent number of the SCIENTIFIC AMERICAN I noticed an article entitled "The Musketo Pest," with an invitation for suggestions of means of defense against these insects. "Persian Insect Powder" and Carbolic Acid are mentioned as remedies, but in either of these cases many would consider the remedy worse than the disease. The only remedy is the exclusion of the musketo from the dwelling. This is attempted by a fine netting stretched over the windows and doors. These are of various fabrics, cotton being the material chiefly employed. But the fibers of cotton, even if sized or starched, will spread themselves across the interstices of the netting and prevent the cooling currents of air from entering; and they are easily torn, when they become valueless for the purpose intended. I have tried the various kinds of musketo netting, and find that the only proper material is wire cloth. It not only excludes all insects, but, the material being smooth, permits the air to pass freely between the meshes. They can be made plain, or so woven as to present agreeable patterns and pictures to the eye. Such screens should be kept in stock by upholsterers.

Clinton, Mass. G. F. W.

Occult Properties of Numbers.

MESSRS. EDITORS:—Permit me to add to the examples of "extraordinary coincidences" mentioned in the current volume of your valuable journal first on page 227, and afterward continued by Mr. Konvalinka on page 259.

As a professed believer in the occult properties of numbers first expounded by Pythagoras, the number 27,648 has been the object of some study by me. In the first place it is exactly equal to the series $1^1\times2^2\times3^3\times4^4$ and as I believe "that such a remarkable coincidence can not be merely accidental, it must have some deeper foundation in the mysteries of astronomy," such, for example, as the number in which the vast cycle of the precession of the equinoxes is completed. It is true that astronomers do not make the years exactly those I have given, although very nearly identical; so nearly, in fact, that we may well suppose the difference to be due either to imperfection in apparatus or to some "personal equation" or other in observation, for you will notice that the first two digits (27) is a cube ($=3^3$) and the last digit (8) is also a cube (2^3) that the middle digit is twice the cube root of 27 and that the other digit (4) is twice the cube root of 8 and that finally the sum of all the digits is exactly equal to the two first (27) whose cube root is 3 and whose sum is 9 the square of 3

If now the order of the digits is reversed it becomes 84,672 which contains the original number exactly $\frac{49}{16}$ times. Both terms of the fraction expressing the ratio are perfect squares, which are contained a whole number of times in the reversed qnantity and their square roots ($\frac{7}{4}$) differ exactly by that constantly recurring number 3, the terms (49—16) differ by 33 Again the 84,672 is divisible without a remainder by the squares of all the digits except 5 and 9, that is, by 1^2 2^2 3^2 4^2 6^2 7^2 8^2 and also by the cubes of 1 2 3 and 4. The sum of all the digits 8+4+6+7+2=27 the cube of 3 the first two digits (84) minus the last two (72) is exactly twice the middle digit (6) the exact difference of the first (8) and last (2).

The sum and the difference of 84,672 and 27,648 are 112,320 and 57,024 which can be shown to possess remarkable properties but I forbear to speak of them as well as of several properties of the other numbers having made this communication as long as I dared. WM. G. LEONARD.

Cincinnati, Ohio.

Diagram of the Day Line.

MESSRS. EDITORS:—In the SCIENTIFIC AMERICAN (Vol. XVII., No. 16, page 246) you say that a Mr. Lyman Thayer, of Burlington, Vt., has invented an admirable device for illustrating the day line, etc, and also for telling the relative time of any two points on the earth's surface. Now I have not seen Mr. Thayer's diagram, but the one herein inclosed (completed a month ago) I suppose to be very similar. It, however, is by no means exact, but is only intended to give an idea of the invention. I have taken for the day line the 180th meridian from Greenwich. It can readily be seen that a similar diagram can be made of the southern hemisphere, and also that the device can be applied to all maps, to tell

the difference of time between any two points represented on the map. I should have written sooner on this matter, but was waiting until I could finish a large and accurate diagram to send you.

If the 180th meridian be taken as 12 o'clock, 15° E., or the 165th meridian W., represents 1 o'clock, and 15° W., or the 165th meridian E., represents 11 o'clock, etc. According to this I propose to number each meridian, allowing of course 4 minutes to the degree. Any meridian may be taken as 12 o'clock, but this alters all the others. W. R. SHELMIRE.

Philadelphia, Pa.

LENHART'S SPRING FISH-HOOK.

The engraving accompanying this description represents a device for contravening the proverbial want of success of fishermen. It is a double hook, one, A, being the bait hook, and the other, B, the securing hook. Fig. 1 shows the hook

Fig. 1

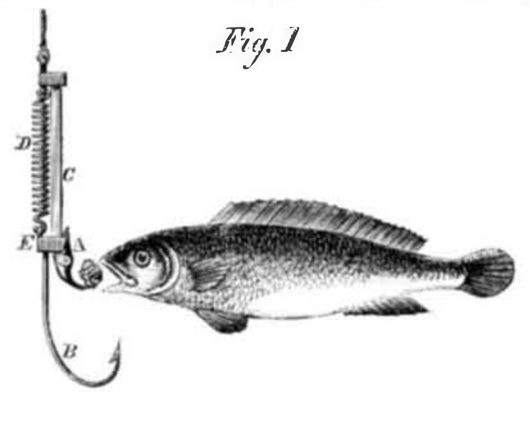
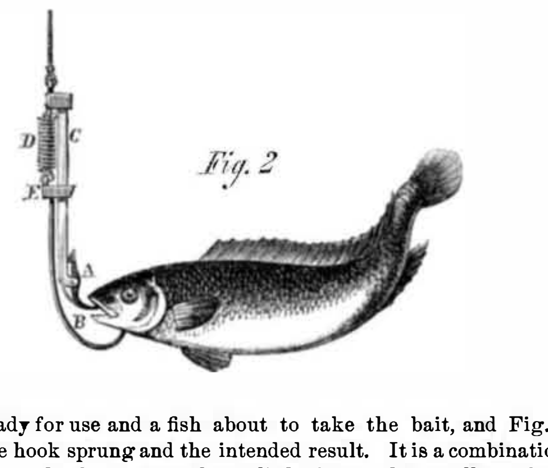


Fig. 2



ready for use and a fish about to take the bait, and Fig. 2 the hook sprung and the intended result. It is a combination of two hooks, connected in a light frame, the smaller or bait hook being pivoted to the bar, C, at its lower end, and the larger or securing hook attached to the spiral spring, D. By pulling down the large hook the slide, E, is engaged with the hook, A, which has a catch on its back and a light spring to throw the catch in place. A slight pull on the small hook, or such a disturbance as may be made by a "nibble," must disengage it from its catch and allow the spring, D, to act, when the fish is held by the larger hook, as seen in Fig. 2. To disengage the fish and to bait the hook anew, the larger hook is pulled down by one hand, while the other holds the top of the bar. It appears to be cruel to the fish—a consideration which probably has little force with anglers—but, unless carefully used, may also be dangerous to the fisherman. A patent for this device is now pending through the Scientific American Patent Agency. All communications should be addressed to the inventor, A. I. Lenhart, New Brunswick, N. J.

Imperfection of Malleable Iron.

It has for some time past been known, that the fibrous nature of iron, long considered an element of its strength, is in reality, due to the presence of foreign matters, which are taken up during manufacture, and prevent the adhesion of the adjacent particles of the iron, however carefully or powerfully the metal may be compressed, or however it may be twisted, doubled up, or contorted. The effect is similar to that which occurs with a glass tube hermetically sealed at both ends; however it may be drawn out, however often it may be doubled or twisted together, at even a very high temperature, the air, a foreign substance within it, will prevent the union of its particles, and cause it to have a fibrous appearance, without adding to its strength, but the contrary.

The imperfection of malleable iron from this cause has now been found far greater than was suspected. It has been shown, by experiments made on French and English armor-plates, that, however homogeneous they may seem when cut and polished, whether formed by the rollers or the hammer, they consist of laminæ not at all welded together, and presenting an appearance similar to that of a number of sheets of paper. This condition has been revealed unmistakably by the effects produced by projectiles; and it is found to be present even when the plate has been both hammered and rolled at a welding temperature.

This discovery assumes a still more serious character, if possible, when there is question of such forgings as railway axles, screw shafts, the shafts of marine engines, and other portions of machinery, the soundness of which is of vital importance. It explains the difficulty of constructing large forgings of requisite strength; and leads, unfortunately, to the conclusion, that without fusion, as in the case of steel, there can be no adequate security with regard to the homogeneity, and therefore the strength of the material.

The intense heat employed in the manufacture softens the scoriaceous matters, but they are never expelled. This is true, to a greater or less extent, even with charcoal iron. The only advantage possessed by the charcoal iron, in this respect, seems to be that the laminæ do not separate during fracture under the blow of a projectile, which is a most trying test of the amount of their adhesion.

It is worthy of notice that the laminæ are more distinctly perceptible, the better the iron, and the more capable of resisting fusion at high temperatures. Fusion seems to be an indispensable condition for the prevention of a laminated structure; hence the excellence of metal such as steel, which is subjected to fusion during manufacture. When fusion has taken place, the rolls and the hammer impart new and valuable qualities. The so-called fibrous character of iron causes its practical to be far less than its theoretical power of resistance; and when it begins to give way in the shafts of marine engines, etc., the fracture commences along lines of junction of the laminæ; and the results of numerous experiments seem to show that, while the welding is very imperfect in those portions to which the shock of the hammer cannot reach, it is in all more or less faulty.—*The Scientific Review.*

A Singular Fact.--The Effect of Variable Calibers in Foam Pipes.

It is known to engineers that some practitioners believe that running a pipe from the steam space to the water space, outside the boiler, and attaching their gages thereto, will give them notice of foaming, or priming, and assist in the prevention of these annoyances. We have a letter from a Maine correspondent who says, that on the Portland and Kennebec railroad is a freight engine which has a "foam pipe," tapped into the top of the boiler, running down, and tapped into the leg-water space of the fire box, just above the foot board; which leaves the pipe about three feet long. Into this pipe a water gage is fitted. When the steam is on and the throttle opened, the water in the boiler rises a little, of course; but in the gage it falls at the same time nearly two inches. Still, when the gage was closed the glass would show the two inches of water.

This case, if we can understand it from the letter of our correspondent, is a curious one, but not singular. We have seen but one case similar, but have heard of one other. In both these cases the holes tapped in the steam space and in the water space were at first of varying diameter; that in the steam space being much smaller than that in the water space. In the one case, where the upper hole was half-inch and the lower three-fourths, we failed to get a reliable water level on the gage. In the other case the experimentor finally got a reliable gage by making both holes of the same caliber. The "reason why" we confess we do not understand. We have our theory, but prefer the evidence of those who have investigated more fully than we did.

THE NOVEMBER METEORS.—Just one year ago the public mind was much exercised at an expected display of celestial pyrotechnics which astronomers predicted would be of unusual brilliancy. Disappointed on that occasion, it is hardly to be expected that the same enthusiasm will be exhibited this year, although it is possible that the shower may make its appearance. In the year 1832, the inhabitants of Europe were favored with a meteoric display, which on the succeeding year delighted the American population. Last November the Europeans were again favored, and certain astronomers are confident that the present month will witness a repetition on our side of the water.

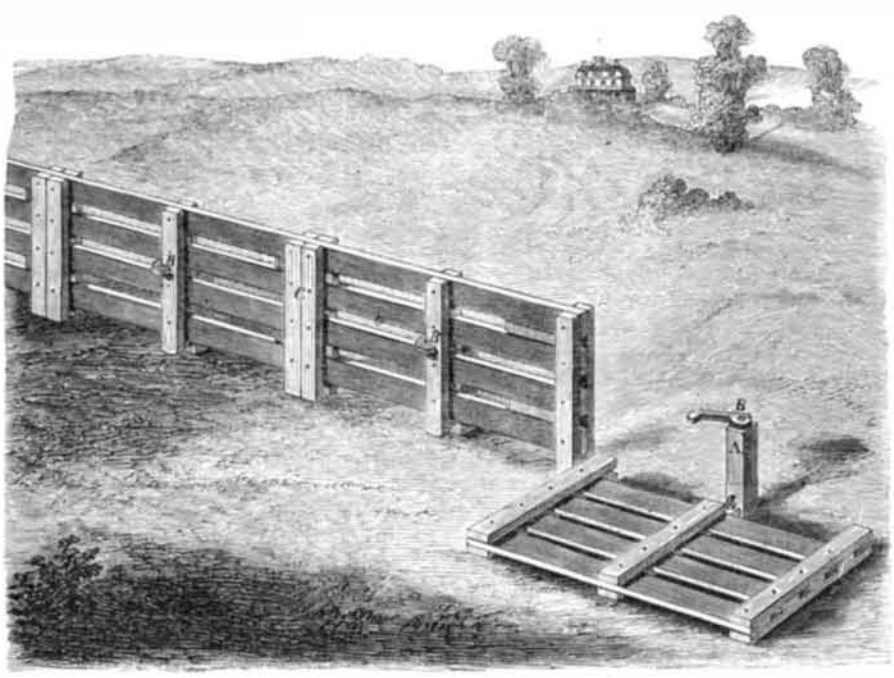
Improved Fence for Submerged Lands.

Throughout the country there are alluvial lands, which, while possessing a rich soil, are kept from yielding any benefit to the cultivator by the certain, or uncertain, contingency of an annual overflow. In many cases dyking is too expensive a process, and when an overflow or freshet occurs, fences, and even outhouses and barns are swept away by the flood. To protect fences, under such circumstances, from being carried away by the flood, is the object of the device illustrated in the engraving.

The permanent posts are quite low, as seen at A, and are firmly seated in the ground. The sections of fence are linked or hinged to these parts, and held in an upright position by means of a latch or catch, B, either of wood or metal, pivoted to the top of the post, and engaging with the middle upright of the section. The sections are secured one to the other by means of wooden keys, or wedges, seen at C, which lock the line together and make a secure and rigid fence. The short posts sustain the whole weight of the fence.

When the water rises, and there is danger of a destructive overflow, the keys may be driven out and the fence be allowed to fall flat on the ground, the sections being prevented from being carried away by their connection with the posts. The prostration of the fence need not be effected until the water is half way up the hight of the fence, when the work can be done by means of a boat. It is evident that in some situations such a device would be invaluable.

It was patented through the Scientific American Patent Agency, Aug 20, 1867, by L. H. Bowlus, who may be addressed relative thereto at Knoxville, Tenn. The entire patent, or State rights for sale.



BOWLUS' LAY-DOWN FENCE.

Lapis Lazuli.

The name of this mineral is derived from the Persian language, and means blue color, or, with the Latin prefix, blue stone. The ancients were well acquainted with it, and have employed it as a substitute for other gems. The Greeks and Romans are said to have called it by the name of sapphire, denominating that with specks of iron pyrites the *sapphirus regilus* ; Pliny called it the *cyanus*. It was formally used as a strengthening medicine.

Lapis lazuli very seldom occurs crystallized ; its regular form is the oblique four-sided prism ; it mostly occurs compact, and in grains and spects, with an uneven and conchoidal fracture ; it is translucent on the edges ; its luster is nearly vitreous and shining ; structure foliated ; its color is fine azure blue, with different shades, often interspersed with spots and veins of pyrites. It scratches glass, but is attacked by quartz and by the file ; its specific gravity is 2·3 ; before the blowpipe and on charcoal it with difficulty runs into a white glass, but with borax it fuses with effervescence into a limpid glass, It consists of lime, magnesia, and silex, with soda, protoxide of iron, and sulphuric acid.

It is generally called in trade, the Armenian stone.

It is found in gangues of the older formations, and in Bucharia ; it exists in granite rocks, and is disseminated in all veins of thin capacity ; on the Baikal Lake it is found in solid pieces ; also, in Siberia, Thibet, China, Chili, and Great Bucharia. Lapis lazuli is much used for jewelry, such as rings, pins, crosses, ear-rings, etc. The best pieces are generally cut out from larger lumps by means of copper saws and emery, then ground with emery on a lead wheel, and polished with rotten stone on a tin wheel. The rocks which yield lapis lazuli, where it is contained in specks, are likewise cut for ornamental purposes, such as snuff-boxes, vases, candlesticks, cups, columns, cane-heads, etc. ; also, for architectural ornaments and stone mosaic ; the larger specimens, having specks regularly disseminated on a white ground of the rock, are those selected for cutting. The most important use of this mineral is that of furnishing the celebrated and beautiful pigment called ultramarine blue, used by painters in oil, and said never to fade. The lapis lazuli takes a very high polish, but becomes dull again after being used for some time. It is sometimes imitated by lazulite (azure stone), or blue carbonate of copper, which, however, is not near so hard, and effervesces on testing with nitric acid. Those specimens having iron pyrites inclosed are difficult to polish well, on account of the unequal hardness of the two minerals.

Lapis lazuli has lately been discovered in California, but the color of the mineral from this locality is very indifferent, and its price is therefore much inferior to that from Persia.

The value of lapis lazuli, although depending upon its purity, intensity of color, and size, has nevertheless much diminished when compared with its former prices.

The Chinese, who have for a long time employed lapsis lazuli in their porcelain painting, call the pure and sky-blue stone *zuisang*, and the dark blue, with disseminated iron pyrites, the *tchingtchang*, preferring the latter to the former ; they work the same for many ornaments, such as vases, snuff boxes, buttons, and cups. In the palace which Catharine II. built for her favorite, Orlof, at St. Petersburg, there are some apartments entirely lined with lapis lazuli, which forms a most magnificent decoration.

The process of preparing ultramarine was known as early as the fifteenth century. The color is now mostly prepared at Rome, in the following manner : those pieces which are free from pyrites specks, are first calcined and pulverized ; the powder is then formed into a mass with a resinous cement (*pastello*), and fused at a strong heat ; this is then worked with the hands in soft water, whereby the finest coloring particles are disengaged in the water, which will soon be impregnated with the blue color ; a fresh portion of water then taken, and the same operation is continued until the remains are colorless. The ultramarine, after a short time, settles to the bottom of the vessels and is carefully separated and dried. If the lapis lazuli be of the best quality, the product will be from two to three per cent. That color which remains yet in the mass is of an inferior quality, and is called the ultramarine ashes ; it is of a paler and more reddish color.

Good ultramarine has a silky touch, and its specific gravity is 2·36. It does not lose its color if exposed to heat, but is soon discolored by acids, and forms a jelly. In order to distinguish the pure ultramarine from numerous spurious and adulterating coloring materials, such as indigo, Prussian blue, mineral blue, etc., it is only necessary to test the article in question with some acid, when after a few minutes the real ultramarine is discolored, yielding a clear solution and a white residuum. The real ultramarine has always been at a very high price, on account of the small product obtained from the mineral. An ounce of the purest ultramarine is sold in France for two hundred to two hundred and fifty francs, which is not within the reach of all painters.

In the year 1828, the discovery was made by Professor Gmelin, in Tubingen, that sulphuret of soda was the proper material for imitating this precious and valuable pigment. By his experiments he succeeded in preparing this substance from silex, alumina, soda, and sulphur, producing a color in every respect corresponding with the true color of the lapis lazuli, and bearing the same relation to acids as the genuine ultramarine. This, for economy, has become a great object to painters and color men, since a whole pound of it may be purchased in France for twenty francs. As it bids fair to meet with a great consumption, being even substituted for cobalt in bluing paper, thread, and other stuffs, several manufacturers have already been induced to engage largely in its preparation ; and there is now a very extensive establishment in full operation by M. Guimet, three leagues from Lyons, who likewise claims the priority of its discovery : the royal porcelain manufactory at Meissen, in Saxony, also prepares it. The process for making the artificial ultramarine, as it was first described by Gmelin, is here given, as it was published in the *Annales de Chimie*. The whole process is divided into three parts :

1. The pure hydrate of silica is prepared by fusing fine pulverized quartz or pure sand with four times its own weight of salt of tartar, dissoling the fused mass in water and precipitating by muriatic acid ; also the hydrate of alumina is prepared from alum in solution, precipitated by ammonia.

2. Dissolve the silex so obtained in a hot solution of caustic soda, and add to seventy parts of the pure silex seventy-two parts of alumina ; then evaporate these substances until a moist powder remains.

3. In a covered Hessian crucible, a mixture of dried sal soda, one part to two parts of sulphur, is heated gradually, until it is fully fused, and to the fused mass add small quantities of the earthy precipitate, taking care not to throw in fresh quantities until all the vapors have ceased ; after standing for an hour in the fire, remove the crucible, and allow it to cool. It now contains the oltramarine, mixed with an excess of sulphuret, which is to be removed by levigation ; and if the sulphuret is still in excess, it is to be expelled by moderate heat. Should the color not be uniform, levigation is the only remedy.—*Feuchtwanger*.

Science Familiarly Illustrated.

Leeches.

This animal has had a reputation from the earliest periods of medical science. Even from the time of Homer, the appellation of leech was given to the practitioners of the art of surgery, and in many of the languages of German derivation the word signifying a physician is identical with that given to the leech. From an English exchange we gather the following facts relative to the life and habits of this species of aquatic worm, which is indeed among the lowest classes of the animal chain of being :—

"There are about thirteen or fourteen species of the leech, some of which are found in most parts of the world ; but the medicinal species is best known, and abounds in various parts of the world—as America, Russia, Hungary, Spain, Portugal, in the marshy plains of Egypt, and in various parts of Asia. It belongs to the class *annelides*, or ringed worms, its body being composed of a series of rings, or circular muscles, by the successive contraction of which it moves along either in the water or upon the surface of leaves, reeds, or other solid bodies. The tail extremity is in the form of a cup, or sucker, by which it adheres firmly to flat substances, on the same principle as a boy's leather sucker adheres to and lifts up a stone. The mouth is also in the form of a sucker, and is, moreover, furnished with three cartillaginous teeth, placed so as to form with each other a triangle. When examined and felt with the point of a finger, they seem soft and blunt ; but the animal, when about to pierce the skin, seems to have the power of erecting them into firm, sharp-edged lancets, which saw through the integuments in a single instant, and almost without inflicting any pain. Having made the puncture, the blood is extracted by a process of suction, and is passed through the œsphagus into the stomach, or rather stomachs, of the animal, which consist of a series of communicating cells, that occupy the greater part of the interior of its body. The leech having thus gorged itself to the utmost, if undisturbed, remains in a half-torpid condition till it has digested its gory meal, and not unfrequently dies of the surfeit. If it survives it will be greatly increased in size. They can live for months and years on what appears to be pure water alone. This forms the singular circumstance in the diet of these animals. They delight to gorge themselves with a full meal of blood, even to surfeit ; and yet with plain water they live, grow, and seem to have the greatest enjoyment of existence. It would appear as if their three lance-formed teeth, and their carniverous appetites, were bestowed more for the benefit of man than for themselves, and that, in their system of dietetics water is the rule and blood the exception.

The medicinal leech is a native of many parts of Britain, but is now becoming very rare. France is supplied chiefly from Strasburg, whence they are imported from Hungary, Turkey, Wallachia and Russia, and kept in ponds. They are carried into France on spring wagons, and are contained in moistened bags, each bag containing 120 leeches. Previous to 1834 upward of 46,000,000 of leeches were imported into France annually. At present the numbers have decreased to 17,000,000. They are imported into London and Leith by sea, packed in little bags, which are occasionally moistened with water during the short voyage. In general they arrive fresh and healthy ; but they are not unfrequently liable to disease, which destroys great numbers. There are three sorts, or sizes, the largest and middle sorts being reckoned the best. A large leech is calculated to abstract half an ounce of blood, besides the quantity which flows from the wound afterward. The smaller sizes are comparatively inefficacious.

A common animal in the pools of this country is the horse leech. It nearly resembles the other, but is of a more uniform color, and not so decidedly marked with greenish streaks on the backs as the medicinal species. The horse leech has no great inclination to fasten on the human skin, but when it does so it takes its fill, just like the other, and no more. There is a popular but unfounded belief that if a leech of this description do fasten on the skin, it will continue to suck and discharge the blood till every drop in the body is exhausted. Hence they are the dread of every school boy who happens to wade with naked legs into their dominions.

The leech, like many other animals, appears to have a very nice sensibility in regard to atmospheric changes, and especially what regards the electric modifications of the air. Beform storms, or any sudden change in the atmosphere, the leech is seen in great activity, and darting up to the surface of the water in its jar. These animals, too, at certain times, are found to move out of the water, and remain for a considerable period clustered on the dry upper surface of the jar ; while on other occasions they will remain for days immersed in the water near the bottom. They produce small eggs, which form into cocoons, from which in due time the living young make their appearance.

Grindstone Grit as a Substitute for Fire Brick.

Mr. Ludwig Wolf, who has charge of a number of the tempering furnaces in the ax factory at Collinsville, Conn., says that "noticing the great amount of fire brick required to keep them in order, I thought of using grindstone grit—of which we have a large quantity—knowing the adhesive quality of the grit. I tried it, and found it to work well. It does not last so long as fire brick, but it keeps the fire cleaner than the brick, and does not form clinkers so fast. I do not know if it will work as well in fires where a heavy blast is required, but if it will it is cheap enough, as for other purposes it has little value."

Silica is the principal ingredient of grindstone grit, together with oxide of iron. It would appear to be well adapted for lining such furnaces as our correspondent manages.