each from 30 to 40 feet in length, which are securely partitioned off and firmly fastened, and by which the miners ascend and descend. The shafts are also provided with massive hoisting apparatus, a large bucket being used in case the descent is perpendicular, but a tramway and a car known as a "skip," if it is inclined. Tramways are all placed in the levels to transport the rock to the shafts, provided with small cars. A large pump is carried to the lowest depth of the mine and kept continually in motion, and in occasional cases artificial ventilation is furnished in remote portions by means of air tubes, connected with a fanning machine on the surface.

When the mine has been thus opened and the necessary machinery provided, parties of miners commence to "stope," to remove, by blasting the rock which either surrounds or contains the mineral. "Stoping" is therefore the main business of the mine, to the wants of which all the other operations are subservient. "Stoping" parties, with one of the levels or shafts as their base, take out all the "vein matter," as the copper-bearing rock is termed, leaving here and their natural pillars to sustain the ponderous roof, whose weight, no timbers, however massive, could support. The copper is often found in enormous masses, and then it is handled with great difficulty. It cannot be drilled, and it is too tenacious to be blasted. The rock is therefore removed from its surface as much as possible, and holes are drilled below it. Immense sand blasts, consisting of many kegs of powder, are placed underneath, and by several of these it is torn from its stony fastenings. In the Minnesota mine, a mass of copper was found which weighed 450 tuns, and in one of the sand blasts, which were placed under it, 33 kegs of powder were used. At the same mine, a mass of copper of about five tuns, found some 18 feet beneath the surface was thrown by one of these large blasts through the over-laying earth high in the air, and fell many feet off in a deep ravine. When these masses are too heavy for handling, or too large for transportation through the narrow levels, they are cut up with coal chisels, a tedious but the only efficacious process. The copper is also obtained in small pieces of a few pounds, and this is called "barrel work." Mass and barrelcopper are generally freed from all the rock possible with the pick and hammer, and thus shipped for smelting. The third variety of the mineral is found in small grains scattered through the rock, and this is crushed in the stamp mills, freed from the rock by washing, and shipped under the name of "stamp workr." Considerable native silver is found mixed with the copper, but most of this is abstracted by the miners, and never reaches the company. The Cliff mine, however, obtained $1,800 worth of silver from their stamp work last year. Openings, similar to the shaft, are frequently made for various purposes from one level to another, or from a level to the surface; these are called "winzes." Often, also a species of "level" is started at right angles with the general openings of the mines, *i. e.* running across instead of with the formation of the copper-bearing rocks; this is termed "cross cutting," and is generally used for "pros peeting," or determining the character and value of the adjacent strata.

This account would not be complete without some brief allusion to the enormous amount of surface improvement, which is as necessary to the successful prosecution of mining operations as the underground labor. The ground has to be cleared, and houses erected for the accomodation of the officers and employes of the company. Miles of road are made to connect the mine with the nearest port, both to secure supplies and also a market for the copper. Ponderous and expensive machinery must be imported, and stamp-mills machine-shops, forges, kilns, sheds, barns and offices constructed. A large dam must be built to secure constant supply of water to wash the stamp rock. An enormous quantity of fuel must be supplied. Few people realize the tremendious consumption of wood resulting from this cause. The demands of a large mine will clear more than 200 acres of woodland in a twelvemonth. Of course many teams and laborers are required in this department of the business alone Stores, capable of filling the wants of the new settlement, must also be started maintained, and all the chief mines possess their own school house and church. All this must be created from nothing, and in the midst of a barren wilderness. It is only when these things are seen that the beholder commences to realize the enormous capital required for mining operations. The prevalent ideas on the subject are ridiculously absurd, and only those who have personal knowledge can form just connections concerning the matter. Every mine necessitates a village upon the surface, as well as vast underground avenues, and when it is stated that there are nearly one hundred mines on the Lake, the mind begins to comprehend the immensity of copper the interest of this section.—*Merchants' Magazine.*

Correspondence.

Western Enterprise.

MESSRS. EDITORS:—I inclose the amount necessary to renew my subscription for another year.

I find that from among all the papers I take, and I take quite a number, yours commands my first attention and is in fact invaluable, and though I am much occupied in the business of cultivating fruits as well as in the business of building the Chicago and Michigan Grand Trunk Railway, from Chicago via St. Joseph to Port Huron, I always occupy a portion of my time in reading the SCIENTIFIC AMERICAN for I am richly paid.

The road I refer to is one of those that is a practical necessity, and one that will pay on traversing a portion of Michigan now, an average of 25 miles from raiload lines, and a section equal to any in the west for agricultural and manufacturing business. The population in the counties it will pass through, is 55,683 greater than was on the line of the Michigan Central Railroad in 1850, and 107,703 in excess of that on the line of the Michigan Southern Railroad, and to day exceeds that of the Michigan Central Railroad, excluding Detroit, by 25,487. The line is shorter than any other between Chicago and New York, and the work is of the very lightest kind.

Fruit will be plenty here from present appearances. Peach crop here last year sold for over $200,000.

J. P. THRESHER.

Benton Harbor, Mich. Feb. 12, 1866.

The Cinder Nuisance.

MESSRS. EDITORS:—I am extensively engaged in the manufacture of shingles at this point. Burning in my arch, saw dust shavings and etc., all pine. My mill is situated under a hill, on the high ground, and west of my factory are private residences. They complain of the cinders from my smoke stack. I write you for information whether there is any way to prevent cinders, either by burning the smoke or by setting the boiler, or by screens, so as to not destroy the draft. My fuel of course is green. I use a 12 foot boiler with small return flues.

Please answer as early as possible in your truly valuable paper, as the information will be valuable not only to me but to hundreds of others, who de sire to carry on manufacturing in cities without any complaint from others.

E. H. HOLLISTER.

Rochester, N. Y. Feb. 5, 1866.

[You should use a bonnet on your smoke stack, so enlarged at the top, like a funnel or an umbrella, that the draft will not be checked. You will find several bushels of cinders in the bottom of your smoke box instead of on the neighbors clothes hung out to dry; $3\frac{1}{2}$ x $3\frac{1}{2}$ mesh, No. 13 wire, will answer well.—EDS.

Gear Wheels.

MESSRS. EDITORS:—I have recently observed many articles in your journal, upon setting out gear wheels. Permit me to suggest that the main point is overlooked, which I think is: Are the teeth to be stepped or pitched as chords of the arc, or as so many fractions of the circumferential line?

If the first be correct, the dividers or compasses will be set at the desired pitch at once, and this pitch or chord will be the same for all wheels of the given pitch; and if the latter mode be correct, to get the diameter of a wheel for a certain number of teeth of a given pitch is the simplest matter possible. You multiply the desired number of teeth by the given pitch line, and it will result that the actual pitch stepped off as chords will be different for every different diameter though the nominal pitch be constant.

I have put the above question to those supposed to be well posted, both as mechanics and mathematicians, and I have never yet received either a prompt or positive reply.

I shall be pleased to learn the views of experienced millwrights upon the point.

INQUIRER.

New York, Feb. 12, 1866.

Gilders' Composition for Frames, Etc.

MESSRS. EDITORS:—The composition at present in use is composed of best black glue, common rosin and linseed oil. Some use rosin oil, others boiled linseed oil. Nearly every manufacturer has a little change in the proportions, but in Europe, as in America, the above ingredients are those used, and are held as a secret. It is a useful material for many other purposes to which it might be applied were its mode of manufacture known.

Take ten pounds of best black glue, boil it in the usual manner, but with very little water. It should be at least four times as thick as carpenters' glue, as used for general purposes. Take six pounds of common rosin, and pound to dust; add linseed oil, or rosin oil, to form a thick paste with the dust, dissolve with heat, allow it to cool to about 212°, then add the rosin compound and the hot glue together; combine it well. Have sifted whiting prepared and combine the whole as in making bread; form it into cakes, and allow it to cool; at any time by the application of steam or heat, this composition may be brought into use.

THOMAS TAYLOR.

Washington, D. C., Feb. 10.

Use of an Invention.

MESSRS. EDITORS:—Will you please throw light upon the following query. A person has invented several machines for expediting the manufacture of certain articles, and has allowed the machines to be used for one or two years in his employers' establishment, but nowhere else. Will such use prevent his securing patents if the articles are patentable. Please answer by letters if agreeable to your rules.

T. J. M.

Baltimore, Feb. 14, 1866.

[If an invention has been in public use for more than two years prior to an application for a patent, a valid patent could not be obtained. The use of the invention in your own establishment could not be regarded as public use within the meaning of the law.—EDS.

Note from Dr. Agnew.

MESSRS. EDITORS:—In the SCIENTIFIC AMERICAN, of Feb. 10th, I find a report of a lecture recently given by me to home workingmen, "Health, and to How to Keep it." The report is somewhat incorrect, particularly where it says that the British army, in India, lost a brigade a day from the abuse of stimulants, etc. My statement was that, owing to overcrowding in barracks and the large ration of spirits given to the men—6 ounces daily—and want of attention to sanitary policing, the army of 70,000 men lost by death at the rate of a *brigade* A YEAR. A fearful mortality for an army in peaceful camps. The actual death rate produced by the above causes was 69 per 1,000.

C. R. AGNEW.

New York, Feb. 10, 1866.

The Principle of the Hydrostatic Press.

MESSRS. EDITORS:—Will a tube, say half-inch bore, inserted in a tight, strong hogshead, filed with water, burst open the hogshead upon the tube being filled with water—the length of the tube to be, say, 20 feet or more? An answer will settle a disputed point and oblige

A CONSTANT READER.

Baltimore, Feb. 6, 1866.

[A column of water 34 feet in hight exerts a pressure at the bottom of 15 pounds to the square inch, and at other elevations in proportion. If a tube 20 feet long is inserted vertically into the top of a hogshead, and both are filled with water, the pressure at the top of the hogshead will be about 9 pounds to the square inch; and if the hogshead is 4 feet in hight, the pressure at the bottom will be about 11 pounds to the inch. As this pressure is against each square inch, it will be as many times 9 pounds against the upper head as there are square inches in its area; if the head is 3 feet in diameter, it will have an area of 1,017 square inches, and the total pressure against it, tending to push it from its place, will be 9,153 pounds.

If, in place of the confined head, you have a movable piston of the same size fitted into a smooth cylinder, and if your pipe has one inch of cross area with a movable piston fitted into it, then by pressing down the small piston with a force of 9 pounds, you raise the large one with a force of 9,153 pounds; but you raise the large piston through only one-thousandth part of the distance that you press downward the small one.—EDS.

Milling Tool Patterns.

MESSRS. EDITORS:—As you frequently inform machinists on little details connected with the trade, I take the liberty to ask you a question about something that has troubled me.

I recently bought a milling tool of a new and peculiar pattern. I don't know that I can describe it very well, but it was something like the letter L turned upside down all the way round the wheel, as in this figure: ⅂⅂⅂⅂⅂. I applied this tool to a job, but instead of making the same pattern, there was a confused mass of nothing. What is the trouble?

J. J. H.

Philadelphia, Feb. 8, 1866.

[The trouble is in the respective sizes of the work and the wheel. Where such milling tools are used, the circumference of the wheel and the work must agree, or be in the same ratio. If the milling tool is three-fourths of an inch in diameter, the circumference of it will be 2·3562 inches. The surface to be worked on must be divided by this an even number of times. To find the circumference of any given circle, multiply the diameter by $3\frac{1}{7}$th. The confusion arises from one part of the pattern running over the other. If you do not use figures, take a piece of tin, lap it round the wheel, and then make the job four or five times as large, or to suit the wheel.—EDS.

Coating Iron with Copper--Secret Processes.

MESSRS. EDITORS:—Will you be kind enough to send me the address of the gentleman who professes to cover iron with copper? J. E. CARVER.

Bridgewater, Mass,, Feb. 12, 1866.

[We are frequently in the habit of publishing the wants of our readers, and whenever we do so it is sure to bring to us a large number of responses. We can not for obvious reasons publish such replies except as advertisements at our usual rates. We cannot give Mr. Carver the information he seeks, but we presume some of our readers will be able to inform him.—EDS.

THE ALGONQUIN AND WINOOSKI---OFFICIAL REPORT OF THE CHIEF ENGINEERS.

GENERAL INSPECTOR'S OFFICE,
STEAM MACHINERY, UNITED STATES NAVY,
NEW YORK, Feb. 19, 1866.

SIR—The undersigned, appointed by you to conduct the experiments with the competitive machinery of the United States paddle-wheel steamers *Winooski* and *Algonquin*, have the honor to submit the following preliminary report of the result of the trial on Long Island Sound for maximum power of machinery and speed of vessel, and for economy of fuel under these conditions.

It will be followed by a full report, embracing the results of all the trials at the wharf as well as of that on Long Island Sound, together with our conclusions from the same, and all the data *in extensó*.

The trial on Long Island Sound was intended to embrace eight consecutive double runs, between Execution Rock Lighthouse and Faulkner's Island Lighthouse, passing round both. Each double run measured on the vessels' tack was, according to the coast survey chart, 113 geographical miles; but a violent storm accompanied by weather so thick as to prevent the lights being seen beyond a mile or two, and the refusal of the pilots to run in it, terminated the trial after the *Winooski* had performed three double runs, or 339 geographical miles and the *Algonquin* two double runs, or 226 geographical miles. Our data and results are accordingly for these distances respectively.

Neither vessels steered well, but they were about equal in this particular, which, of course, still further lessened their speed. The machinery of both vessels was in excellent order. That of the *Algonquin*, after the completion of the wharf trials, had been for two and a half months in the hands of the contractor for repairs, during which time he had renewed all the vertical tubes of the boilers, substituting a new circulating pump.

In the course of the trial the feed pump worked by the main engine was inoperative ten and a half hours, during which time the boilers were supplied by the auxiliary steam pump; as, however, this pump draws the feed water from the hot well, its substitution in no way affected the performance of the machinery. The counter balance of the eccentric broke at the commencement of the trial, but its fracture was not of the least importance. A paddle on one of the wheels was also broken; but it took place on the return of the vessel to port, and not during the trial.

On board the *Algonquin* the blower was used, but as it delivered the blast into an open fire room its efficiency must have been very small. The steam jet in the smoke pipe was in use, and, with a boiler pressure of 68 lbs. per square inch above the atmosphere, was doubtless very efficient in forcing the draft. On board the *Winooski* the blowers were not used. They are two in number, driven by an independent steam cylinder, and delivered their blast into the ash pits of the boilers, which are closed by air tight doors; when employed, an enormous rate of combustion can be obtained, and a supply of steam much exceeding that used during the trial. A steam jet (a duplicate of that of the *Algonquin*) in the smoke-pipe was employed during the trial, with a boiler pressure of 38 pounds per square inch above the atmosphere.

At the commencement of the trial the *Algonquin's* draft of water was 8 feet 5 inches forward and aft, and the *Winooski's* draft was 8 feet 10 inches forward, 8 feet 8 inches aft. The difference of 4 inches in the mean draft was an allowance made for the deeper false keel of the latter vessel; both vessels being presumed to be in other respects identical, as they were constructed from the same building directions and mold-loft dimensions.

The boilers of the *Winooski* contain 200 square feet of grate surface and 5,036 square feet of heating surface, and have no means of superheating the steam. The boilers of the *Algonquin* contain 144 square feet of grate surface, and 2,678 square feet of heating surface, together with 1,132 square feet of steam superheating surface in tubes. The boilers of both vessels have water tubes. In the *Winooski* they are vertical and are arranged above the furnaces, according to Martin's patent; and in the *Algonquin* they are inclined and arranged in combination with the superheating tubes, according to the patent of Mr. E. N. Dickerson, who designed the entire machinery of that vessel.

Each vessel has one inclined and direct acting engine. The cylinder of the *Winooski* is 58 inches diameter, and its piston has a stroke of 8 feet 9 inches. The cylinder of the *Algonquin* is 48 inches diameter, and its piston has a stroke of 10 feet.

The space occupied in the *Winooski* by the machinery and coal is 57 feet 11 inches long, by the entire breadth and depth of the vessel; and in this space there is a coal bunker capacity of 9,429, cubic feet. The space occupied in the *Algonquin* by the machinery and coal is 85 feet 9 inches long, by the entire breath and depth of the vessel.

The weight of the machinery of the *Winooski*, exclusive of the water in the boilers, is 541,718 pounds, and inclusive of the water, 623,918 pounds. The weight of the machinery in the *Algonquin*, exclusive of the water in the boilers, is 629,144 pounds, and inclusive of the water, 701,144 pounds. The distribution of the weight of her machinery was so faulty that when the vessel was fully stowed for sea, with her coal bunkers filled, water in boilers, etc, she had a list of 22 inches to port, giving her port paddle-wheel an immersion of 7 feet $3\frac{1}{2}$ inches, and her starboard wheel an immersion of 3 feet $7\frac{1}{2}$ inches. To bring the vessel upright, there was required a weight of 73 tuns to be stowed on her decks, in the extreme wing, after the hold had been stowed, in such a manner as to place all the weight possible on the starboard side.

The following are the principal dimensions of each vessel, the greatest transverse section, and the displacement corresponding to their draft of water at the commencement of the trial:—Depth 8 feet $2\frac{1}{4}$ inches, length 240 feet, extreme breadth on mean load water line 35 feet; displacement, 1,280·78 tuns; area of greatest immersed transverse section, 263·85 square feet.

During the time the machinery of both vessels was in operation a complete steam log was kept of their performance, in which was noted, in proper columns, at the end of each hour, the number on the counter, the number of revolutions made by the engines per minute during the hour, the steam pressure in the boilers and in the main steam pipe near the engine, the vacuum in the condenser and the position of the throttle valve, the temperature of the atmosphere on deck, of the engine room, of the fire room, of the injection water, of the discharge water, and of the hot well or feed water; also the hight of the barometer in the engine room. An accurate account was kept of the coal thrown into the furnace each hour, and of the refuse withdrawn from the furnaces and ashpits at the end of each watch of four hours. At the end of every half hour an indicator diagram was taken from each end of the cylinder, and the complete data marked on it at the time taken, and of the number of revolutions of the engine per minute, steam pressure, vacuum etc. A naval engineer was always on watch in the fire room and engine room of each vessel. The point at which the steam valve of the *Winooski* closed and cut off the admission of steam to the cylinder, measured on the main crosshead guides, was 6 feet 4 inches from the commencement of the piston on the lower stroke, and 6 feet on the upper stroke. The mean point of cutting off, therefore, was at seven-tenths of the stroke of the piston from the commencement. As the cut-off of the *Algonquin* was not a positive one, the point of cutting off was obtained from the indicator diagrams, and is the mean given by them.

The contract for the *Algonquin's* machinery provides that the entire responsibility is to rest with the said party of the first part, who will make their own working drawings, and arrange and proportion the details of the said machinery in such manner as they shall deem best calculated to secure the most successful operation.

The machinery of the *Winooski* has worked in the most perfect manner throughout, and its performance in every particular leaves nothing to be desired for efficiency in a paddle-wheel steamer. Its durability and reliability could be depended upon for any length of cruising. Its workmanship, material, finish, accessories and appointments are first-class throughout. The machinery of the *Algonquin* is wanting in these particulars, and in proper adaptation for marine purposes. In style, finish and convenience for manipulation, and in all its appointments, it is much inferior to that of the *Winooski*.

We find that the machinery of the *Algonquin* developed only 54·29 per centum of the power developed by the *Winooski's* machinery, and that the cost of the indicated horse power in pounds of anthracite consumed per hour with the machinery of the *Algonquin* was 18·58 per centum more than with the machinery of the *Winooski*, taking that of the latter for units. If the comparison be made as it properly should be, for economy of fuel, by taking the combustible matter of the coal, instead of the coal itself, for the expression of the cost of the power, as the per centum of refuse in ashes and clinker in an accidental and variable proportion, then the cost of the indicated horse power in pounds of combustible consumed per hour with the machinery of the *Algonquin* was 23·28 per centum more than the machinery of the *Winooski*. In this most important guarantee for amount of power and economy of fuel this failure of the contractor is the greatest of all, resulting in a loss of speed of nearly two geographical miles per hour, and a large increase of the cost of the steam power, *pro rata*.

In every point guaranteed by the contractor for the *Algonquin's* machinery he has failed, and we are of the opinion that it is totally unfit for the naval service. The steam logs of the experiments and the indicator diagrams are herewith forwarded.

ROBERT DANBY,
EDWIN FITHIAN,
MORTIMER KELLOGG, } Chief Eng'rs, U.S.N.

JOHN B. WOLFF will oblige us by sending his Post Office address.