Correspondence

Fusible Alloys and Their Discovery.

MESSRS. EDITORS:—Having in my former communication given an account of the new "Fusible Metal," it may not be out of place, in the same connection, to say something about the discovery of this and other fusible alloys. But not to be considered as having written to meet a particular case, I will quote from an article published in January, 1863, in the *Dental Register of the West*—being one of a series of articles on "Metals and Alloys," communicated to that journal. As the *Register* is limited in circulation to the profession (chiefly in the Western States), the remarks quoted may be, to most of your readers, the same as though now first published. Speaking of bismuth, reference is made to its fusible combination, as follows:—

"As an ingredient in alloys, bismuth has long been pre-eminent among metals for its property of promoting fusibility. The most remarkable instance of this is afforded in certain combinations with lead and tin, distinguished as fusible metal; also called Newton's alloy, from the original discoverer; also Rose's, or Darcet's metal—the former having made a supposed improvement in the formula, and the latter having re-produced it in France for dental purposes. Newton's alloy consists of 3 parts of tin, 5 of lead, and 8 of bismuth; another formula is given of 2 parts of tin, 3 of lead, and 5 of bismuth; Rose's formula is, 1 part of tin, 1 of lead, and 2 of bismuth. It is remarkable that in nearly all of our scientific books, the melting point of Newton's allow is given as 212°, while Rose's is 202° or 200·75°, whereas there is scarcely any difference, either in fusibility or other qualities, both melting at about 200°. To close tests the order of fusibility stands as follows:—*First*, the mixture of 2 parts of tin, 3 of lead, 5 of bismuth; *second*, 1 of tin, 1 of lead, 2 of bismuth; *third*, 3 parts of tin, 5 of lead, 8 of bismuth—there not being more than one or two degrees difference between the first and last. To the thermometer inserted in the melted mass they were all perfectly fluid at 200°, and perfectly congealed at 198°.

"Newton's alloy is adduced in all the chemical text books to illustrate the effect of combination in promoting fluidity, and the property of bismuth as a fluidifying agent. Although different formulas are given of this alloy (3 parts of tin, 5 of lead, 8 of bismuth; 2 of tin, 3 of lead, 5 of bismuth; 1 of tin, 1 of lead, 2 of bismuth, etc.), they are all substantially the same in properties, melting at a similar temperature, being fluid at about 200° Fahrenheit, when the bulb of the thermometer is immersed in the melted metal, and if tested in water, varying from 205° to 208°. Heating in water does not, according to my experience, indicate as low a melting point, nor as uniform results, in the case of these or of other fusible alloys, as when the other mode is adopted. [For remarks on "Determining the Melting Point of Metals," see *Journal of the Franklin Institute*, vol. XLIII., page 61; also copied in the *Dental Cosmos* for February, 1862.]

"This combination afforded the most fusible alloy known until quite recently. Of course the addition of mercury, itself fluid at 39° below zero, lowers its melting point in proportion to the quantity added, by simply communicating its own fluidity to the mixture, but without imparting any new property, forming not an alloy proper, but an *amalgam*.

"But within the past four or five years, three distinct alloys have been added to the list, one being but slightly less fusible than that, and two much exceeding it in this property; the discovery of all of which happened to fall to the writer of this paper.

"The first discovered (June, 1858,) consists of the three metals—bismuth, tin, and cadmium. The most fusible proportions of this alloy appears to be three parts of bismuth, one of tin, and one of cadmium, although a little increase of either of the two last named metals does not alter the result. It is fluid around the bulb of the thermometer at about 210°, and congeals between 200° and 204°. Tested in hot water a higher melting point is indicated.

"The next (discovered same date) consists of the four metals—bismuth, tin, lead, and cadmium—forming the most fusible alloy we have, which is well enough known, having been repeatedly referred to in the scientific journals. [This is the alloy spoken of in our former communication, which see for proportions, etc.] It is fluid at 150°, and congeals at the same degree. Melted in water, it fuses between 150° and 160°, and is hard at 150°. Professor Silliman gives its melting point at about 158°; but Lipowitz puts it as low as 140°. Perhaps my own measurement expresses it as nearly as any, being about the mean between the two, and the result of carefully-repeated tests.

"The last consists of the three metals—bismuth, lead, and cadmium. In October, 1858, I noted that two parts of bismuth, one of lead, and one of cadmium, melt at a heat so low as to soften (without becoming fluid) in boiling water; and again (April, 1859), that four parts of bismuth, two of lead, and one of cadmium become fluid at the same heat; but, although noting the fact for further inquiry, neglected to follow it up at the time, and it finally slipped my memory until November, 1861, when, on contrasting the two notes, I resolved to trace up the ultimate results, which proved the most fusible combination of these metals to consist of seven parts of bismuth, six of lead, and one of cadmium, forming an alloy fusible at 180°, or, in water, a few degrees higher, being the most fusible alloy known that consists of but three metals—a most remarkable result, considering the small proportion of cadmium employed, and the high melting point indicated by the mean of the constituents." B. WOOD.

The Power Required to Drive Machinery.

MESSRS EDITORS:—To answer this question depends upon so many conditions that it seems doubtful if a satisfactory reply can be given; not because a certain amount of labor does not require a definite amount of power to perform it; but in which it is to be performed, the quality of the work produced, and the particular kind of tool used, all have a bearing on the result.

The speed with which machines are capable of performing labor sometimes, is limited by the machine itself—as is the case with sash and muley saws, common millstones, and others. Circular saws and some other machines are almost without limit, except in the amount of power employed.

In operating circular saws and grist mills, I have made it a special point to ascertain accurately, by means of a dynamometer, the power consumed by each machine performing in its daily labor

I will give my experience with circular saws. These were three in number, one 54, one 39, and one 16 inches diameter. They were tried under similar conditions, as regards kind of timber sawed, etc. The power required to drive the points of the teeth through the timber, alone, was considered—that accumulated in the motion of machinery or momentum, was carefully excluded, as was also all friction except that in the bearings of the saw shafts. The 54 and 39-inch saws were each run 300 revolutions per minute; each had 20 teeth, as had also the 16-inch saw; all three had the same feed or forward cut—$\frac{1}{16}$ of an inch, and, of course, advanced $1\frac{1}{4}$ inches each revolution.

With the 39-inch saw, to cut a board 6 inches wide at the rate of 32 feet in length per minute, required 12 horse-power. To cut a board one foot wide at the same rate, 32 horse-power was required. With the 54-inch saw, to cut a board one foot wide at the rate of 32 feet per minute, required but 25 horse-power. This saw being larger had an advantage of allowing each tooth to cut nearer its proper distance forward than the other; and it also should be observed that while it had scarcely two teeth cutting at once, the other had three.

This illustrates a very important point in the operation of saws generally, viz., it requires little, if any, more power to drive a saw tooth, cutting forward $\frac{1}{16}$ of an inch, than it does to cut forward less, or even one-half that distance; especially is this true in sawing pine, or other straight-grained and soft wood. In sawing hand wood a less forward cut is necessary; not that it is any saving in power while the saw is running in straight-grained wood, but in order to make a clear cut in cross-grain knots, etc., because here the sides of the teeth are to cut as well as the points.

Saws with a great many teeth are sometimes used, running at a high speed, being more like a filing or rasping operation than sawing—an advantage to file makers, perhaps, but a great loss in producing lumber. The only advantage ever assigned for this worse than foolish method, is, that thus a saw is not apt to run out of line; but a properly dressed saw does not run out of line, will last a great deal longer, do more work, and save files and filing.

The other, a 16-inch lath saw, making 3,000 revolutions per minute, required twelve horse-power when sawing pine lath as fast as two men could handle them.

To deduce a rule from which the number of feet of lumber—board measure—may be sawed per minute, we must, according to these results, consider the thickness of the saw kerf, and, also, whether each tooth is at all times cutting its proper distance forward.

The 54-inch saw, making a kerf $\frac{1}{4}$ of inch wide and sawing boards one foot in width, required one horse-power to saw 1·30 feet per minute.

The 39-inch saw, kerf $\frac{7}{32}$ sawing the same width of boards, required one horse-power to saw one foot per minute. The same sawing a board six inches wide, required one horse-power to saw 1·33 feet per minute.

In these results there is no great variation, except in the advantage of the smaller saw cutting the wider board, but when we come to consider the lath saw making $\frac{1}{3}$ of an inch kerf, the difference is great. This saw required but one horse-power to saw 2·66 feet per minute.

A correspondent asks the power required to drive the different sizes of circular saws; but the size of saws has nothing to do with the power required; that is determined alone by the width of boards to be sawed. I can only say, that in sawing pine logs, generally, one-horse power will be sufficient to make one foot of inch boards per minute. This leaves the momentum of the fly wheel, etc., out of the question. The advantage to be gained by the use of fly and other heavy wheels, in driving circular saws, is great. A 24 horse-power, with this aid, will, generally speaking, saw as much lumber in twelve hours, as a 48 horse-power would do in the same time, without it. Of course, not that there is any power in a fly wheel, except that accumulated while the saw is not cutting, as in backing the carriage, etc. This generally amounts to more than the cutting time, and, hence, double the work can be done.

The speed at which the teeth of a circular saw is to saw, generally determines the power to be applied, and practice seems to require that this shall not be less than about 50 feet per second. The angle formed by the points of the teeth, their pitch, manner in which they are upset, set, and filed, all are important—and should be carefully considered by any one who would excel in using these most efficient lumber-producing machines.

J. B. REYMAN.

Stockton, Minn., Dec. 5, 1865.

An Apprentice Seeks Information about His Trade.

MESSRS. EDITORS:—Having been a constant reader of your very valuable paper for upward of twelve years, I find that it contains valuable information for all classes; rich and poor, high and low, can find something new every week, yet I think there is one class that get the least, and that is the painters. Can not some of your correspondents post us up a little now? I would like to know how lead and zinc are made, etc. My boss is a gruff kind of a man and don't like to answer questions. What is the best way to mix oil graining? APPRENTICE.

Cranston, R. I., Dec. 5, 1865.

[An apprentice who has "a gruff boss who dislikes to answer questions," is certainly in a bad way to learn anything. Will some of our readers answer this inquiring mind.—EDS.

To Makers of Lathes.

MESSRS. EDITORS:—Can you inform me where such "American Foot Lathes" are to be obtained? Nothing of the kind worth having is to be obtained in this neighborhood for any reasonable price. Our machinists and tool shops do not keep them, and will not get one up without the purchaser will pay for the patterns. At least such was the case two years ago, when I tried in vain to obtain one.

C. H. T.

Boston, Dec. 17, 1865.

Filthy Water Supplied to Cities.

MESSRS. EDITORS:—The Schuylkill river supplies the city of Philadelphia with nearly all the water for all domestic purposes. It takes its rise in the coal regions, in Schuylkill County, about one hundred miles from Philadelphia. All the water from the coal and other mines in that region, are either directly or indirectly emptied into the waters of this small river, which, at some seasons, has not much more capacity than to supply the city with water. The waters from these mines are all more or less acid, some so much so as to destroy the iron machinery used in working them. There are several cities and towns of considerable size and many manufactories of various kinds, some close to the city, the filth and refuse of chemicals of which are washed into this river. I ask, do these acids from the mines, the filth from the cities, towns, manufactories and chemical laboratories, that are washed into this river, impregnate the water, and will not the increase of those washings by and by make the water unhealthy? Do these acids, chemicals, and washings mix with the water, or do they leave and the water become pure before it reaches the basin for domestic use? I think this is a very important matter for the city of Philadelphia, as it depends mainly upon this source for its water. Whether it has ever been thoroughly investigated or not, I do not know. Without making any claim to a scientific knowledge, I do believe that these substances do impregnate and remain in the water, but to what extent I have no idea. That a vast amount of unhealthy matter is washed into this river there is no question; it may be so small, at present, compared with the body of water, as to be imperceptible, the same as it would be if a small portion of poison was put into a hogshead of water—the poison would be there, notwithstanding it would be so diffused that it would be comparatively harmless. What becomes of the deleterious matters? Does the water neutralize them so as to remove their unhealthy properties?

I think our public would like to see the views of some of your scientific correspondents published in your paper upon this important subject. FANNY.

Philadelphia, Dec. 15, 1865.

[Whether the filth and poison in the Schuylkill water is injurious to health, depends entirely on the quantity. If our fair correspondent is so fastidious that she is willing to take the trouble, she may obtain pure water by distilling, filtering and aerating. Get a simple still to set on a cooking stove, and distill all the water intended for drinking, then filter it through freshly-burned charcoal to remove the volatile odors that come over, and finally agitate it in the atmosphere so that it may reabsorb its supply of air to make it sparkling and palatable. A simpler process for obtaining pure water is to melt ice. This process is employed by some of the most eminent physicians in this city for their own families, to avoid the danger of lead poison from their water pipes.—EDS.

Heating Feed for Low-pressure Boilers.

MESSRS. EDITORS:—I want to heat to the boiling point, if possible, the boiler feed of a large low-pressure boiler. The usual method, *i. e.*, taking it from the hot well, is not sufficient; nor can the exhaust, before entering the condenser, be conveniently used. I have thought of passing the feed pipe through one of the main flues or close to the crown sheet, and only the length of the fire-box. Of course the check valve would be changed, so that the pipe should remain full. This plan has been tried on Lake Erie, I think, with what results I do not know. The arrangement would, I think, be safe enough while a current of water was moving through the pipe, but with the pump at rest and the pipe exposed to heat, would it be safe? SUBSCRIBER.

Dec. 12, 1865.

[A pipe carried in the manner suggested by our correspondent is obviously in danger from being burnt so soon as water ceases passing through. Pumps often stop working, when the pipe would get red hot in a short time. A better way would be to put a coil of pipe across the flues in the smoke box, so that the heat would act upon it without danger of burning it.—EDS.

Gun Cotton.

MESSRS. EDITORS:—Among the earliest objections urged against the use of gun cotton was its liability to decomposition. M. Blondeau, in a recent communication to the French Academy of Sciences, recommends a compound of gun cotton and ammonia as "being more stable and less liable to spontaneous decomposition than gun cotton." He proposes the new name of "pyroxilic acid" for "pyroxiline," the present name of gun cotton. I have, at various times, prepared large quantities of gun cotton, and have never witnessed this liability to decomposition, and am inclined to think that, if properly prepared, using pure and concentrated acids, and very careful and thorough washing, it is a stable compound below 200° Fah. It is possible that, when prepared in very large masses, its formation is not so perfect or uniform throughout the mass, and the washing process may not extend to every fiber.

I send inclosed a small sample of gun cotton prepared by myself nearly twenty years since, soon after the announcement of Schonbein's discovery. You will find it on trial to be as good as new, although it has been exposed to all the vicissitudes of this climate during this long period, and for several years of this time in a very damp situation. It is a part of several pounds which I prepared for Capt. Mordecai, with which to test its comparative merits with gunpowder at the U. S. Arsenal. It will be remembered that he reported against its use in the Government service on account of its greater explosiveness, three or four superposed charges bursting muskets of the best quality. As this condition of charges cannot occur in breech-loaders this objection cannot apply, and with all the advantages possessed by this substance over gunpowder, it is to be hoped that it may receive further attention from the Government, and also from manufacturers for sporting purposes, since breech-loaders are now so much in vogue.

CHAS. G. PAGE.

Washington, D. C., Dec. 21, 1865.

A Question in Relation to Water Wheels.

MESSRS. EDITORS:—I wish your opinion respecting a proposed change in the construction of a horizontal water-wheel. I find, according to the "Mechanic's Text Book," pp. 84, 85, that "water is subjected to the same laws of gravity as those of solid bodies, and thereby accumulates velocity or effect in an equal ratio when falling through an equal space, or descending from an equal hight—that its greatest effect is obtained when acting by gravity throughout its whole hight."

If the above be admitted, it seems that there is a loss in the affective power due the falling column of water, from its describing an arc, from 3 o'clock of the circle to 6 o'clock, instead of falling in a perpendicular right line from 3 o'clock until it reached or intersected a parallel line from 6 o'clock. For it seems that the effective power due to a bucket at 3 o'clock is proportionately less at 4, and still less at 5, and nothing at 6, if any remained in at this point of the circle.

Now, if I am correct in the above, it seems to me that I can construct or arrange buckets in or on a wheel, so as to fall vertically from a point level with the axis instead sweeping round the arc.

But do you think it worth the doing, so that it would pay well, and be patentable? A. W. L.

North Adams, Berkshire Co, Mass., Dec. 4, 1865.

[Nothing whatever would be gained by this change. The water exerts precisely the same effect in falling around the arc that it would in descending vertically.—EDS.

A Suggestion to Astronomers.

MESSRS. EDITORS:—A recent article in your valuable paper, in relation to tables for cutting screw threads on geared lathes, suggested the possibility of an astronomical calculation, by means of a series of cogged gearing, properly constructed, which should automatically indicate eclipses, transits, conjunctions, appositions and all regular motions of the planetary system with mathematical exactness, thus saving the trouble of "brain-work" in such matters, other than reading the register and taking notes. I think such an apparatus might be found quite useful in practice, and would be better, every way, for such purposes, than even the best known planetarium, besides costing far less. W. L. D.

Louisville, Ky., Dec. 4, 1865.

Solvent for Shellac.

MESSRS. EDITORS:—One of your correspondents asks if you can inform him of a solvent for shellac, and you replied, that "alcohol was the only menstruum that completely dissolves it," or some such answer. I have not the paper before me, and cannot give the exact words. It may be of some benefit to him to know that a saturated solution of borax will completely dissolve it. J. T. R.

Advantages of Advertising.

Mr. Seymour, P. M., at Hudson, St. Croix County, Wis., in sending a club of subscribers for the coming year, writes as follows:—

"Below please find list of subscribers for SCIENTIFIC AMERICAN, which I have succeeded in getting up for you. I had hard work in raising them, but thought it a shame that but one copy was taken among sixty old mechanics, and that copy my own, who am not a mechanic. I cannot do without it. Many say they cannot afford to take it.

"I saw in it the advertisement of Waits' jouval turbine. Never had heard of it before, but wrote to Mr. Wait once or twice, and got a wheel. It is the best I ever saw, and does more work than he warranted it to. I save 54 inches of water by it over my old wheel—worth to me say $200 per year, or more than the price of the wheel. So much for advertising in the right paper."

NEW AND VALUABLE SCIENTIFIC WORKS.

We have received from Mr. John Wiley, No. 535 Broadway, New York, two most valuable scientific works which he is now issuing. These works are, "Rankine's Ship-building," theoretical and practical, and "A Treatise on the Screw Propeller, Screw Vessels, and Screw Engines, as Adapted for Peace and War," by John Bourne.

Both of these works are issued in monthly parts, the first at $1 25 per number, the second at 2s. 6d. English money. They are profusely illustrated with plates which are, in fact, working drawings, so clearly are all the parts and details given. In the work on screw propellers, the author begins at the earliest attempts, and leads the student on to the latest achievements and best practice of modern builders.

Part I. contains, in addition to the text, a large double-plate page of the engines and hull of the *Great Eastern*, exhibiting the builder's lines, coal stowage, and general arrangement of the interior.

The work will be completed in twenty-four numbers. Every reader of the SCIENTIFIC AMERICAN interested in steam machinery should subscribe.

The work on ship-building is contributed to by the most celebrated English ship-builders, Prof. Rankine of the Glasgow University being the corresponding editor. The hydraulics of ship-building, strength of materials, masts, sails and rigging, the geometry of ship-building; practical ship-building, and marine steam engineering—are all to be treated on in the progress of the work. The mere citation of the contents and the name of the presiding editor, Prof. Rankine, are sufficient guarantees of the invaluable character of the work.

LEADEN pipes were used by Archimedes to distribute water by engines in the large ship built for Hiero. The first improvement on the ancient mode of making leaden pipes was matured in England in 1539. It consisted in casting them complete in short lengths, in molds placed in a perpendicular position. After a number were cast, they were united in a separate mold by poring hot metal over the ends until they ran together.

IN 1678 engines were constructed by Hautefeuille and Huyghens, which derived their motion from the explosion of small charges of gunpowder within their cylinders. In the same year Hautefeuille proposed the alternate evolution and condensation of the vapor of alcohol in such a manner that none should be wasted.