certainly is the most expensive. The alloys of copper, antimony, and tin, or so called white metal, are bad makeshifts, as well as the so called lead composition bearings of lead and antimony; for it is impossible to give these alloys a hardness approaching that of the revolving axle without rendering them brittle. If an alloy is used sufficiently hard to avoid great wear, these bearings will heat much and are very brittle.

On most of the English, Belgian, German, French, and particularly on American railroads, white metal, and especially lead composition, bearings are little used, and this with good reason; for what would become, for instance, of a white metal bearing on an American railroad, where the bearings are subjected not only to heavy loads, but where they have to travel thousands of miles on rails belonging to other companies, and therefore are not much looked after.

Gun metal bearings, alloys of tin and copper, are not often homogeneous, with exception of the alloy of 17 to 18 per cent of copper, which is the most trustworthy alloy of tin and copper. In alloys containing a lower percentage of tin, the latter segregates in the form of tin spots, when the alloy cools slowly. All other compositions in use for bearings, such as 12 to 17 per cent of tin and 88 to 83 per cent of copper, do not make homogeneous bearings, unless they are cast in chill molds, which in practice is impossible. This heterogeneity of gun metal bearings is dangerous, as it produces gripping, and thereby a rapid wear. This specific quality of gun metal bearings (to grip) is theoretically easily explained: In cooling, the softer metal (composed of from 7 to 10 per cent of tin and 93 to 90 per cent of copper), being the less fusible, sets first, forming the skeleton of the bearing; later, the very hard and brittle alloy, containing 17 to 18 per cent of tin and 83 to 82 per cent of copper, sets and fills the pores of the softer skeleton. The particles of the harder alloy are easily torn away by the axle if the bearing is not sufficiently lubricated, and these tear the skeleton composed of the softer alloy; this I have frequently observed at rolling mills where the bearings were not sufficiently lubricated, and where particles in the form of small flakes peel off.

A good bearing which answers all purposes must not be homogeneous, but must consist of a strong and tough skeleton, the hardness of which nearly equals that of the axle, in order to resist shocks without deformation, and the pores of this skeleton must be filled with the soft metal or alloy.

The nearer the hardness of the skelton approaches the hardness of the axle, the better the bearing will resist the pressure or shocks; and the softer the metal filling the pores, the better the bearing is in every respect. Such bearings are now made by melting two or more alloys of different hardness and fusibility together, in such proportions that necessarily a separation into two alloys of definite composition takes place in cooling.

Phosphor-bronze bearings consist of a uniform skeleton of very tough phosphor bronze, the hardness of which may be easily regulated to equal the hardness of the axle, while the pores are filled with a soft alloy of lead and tin.

Such a phosphor bronze bearing may therefore be considered as having its wearing surface composed of a great number of small bearings of very soft metal encased in the tough and strong metal which equals the hardness of the axle; on the planed bearing surface this molecular disposition cannot be detected by the naked eye, but, if examined with a magnifying glass, the truth of the above will at once be seen. Another practical proof can be given by exposing such bearings to a dull red heat, when the soft alloy will sweat out, and the hard, spongy, skeleton-like mass remains.

In this consist the great advantages of phosphor-bronze bearings, which is proved wherever tested; for while the axle partly runs on a very soft metal and thus obviates heating, even if not sufficiently lubricated, the harder part of the bearing, its skeleton, does not allow of wear taking place; and as the hardness is arranged to equal the hardness of the axle, wear is reduced to its very minimum.—*Dr. Charles Kunzel*

Use of Iron instead of Lead Shot in the Rinsing of Bottles.

Lead shot, where so used, often leaves carbonate of lead on the internal surface, and this is apt to be dissolved in the wine or other liquids afterward introduced, with poisonous results; and particles of the shot are sometimes inadvertently left in the bottle. M. Fordos states that clippings of iron wire are a better means of rinsing. They are easily had, and the cleaning is rapid and complete. The iron is attacked by the oxygen of the air, but the ferruginous compound does not attach to the sides of the bottle, and is easily removed in washing. Besides, a little oxidized iron is not injurious to health. M. Fordos further found that the slight traces of iron left had no apparent effect on the color of red wines; it had on white wines but very little; and he thinks it might be better to use clippings of tin for the latter.

Fast Steaming.

One of the finest and fastest steamboats on the Hudson river is the Mary Powell. Recently she made the distance from New York to Piermont, 28 miles, in one hour, while the actual running time to Poughkeepsie, $74\frac{1}{2}$ miles, was 3h. 19m., or at the average rate of $22\frac{1}{3}$ miles per hour. Boiler pressure, 37 lbs. The Powell is fitted with the ordinary single vertical cylinder, walking beam engine.

PARASITES.—It is common to note that each species of animal has its own parasites, which can exist only upon creatures which have more or less kinship with their host. Thus the *ascarix mystax*, which torments the domestic cat, is found in all species of *felis*, while the fox, so closely resembling the wolf or the dog, is never troubled with the *tænia senata*, common in the last mentioned animal.

THE VIBRATIONS OF SOLIDS OPTICALLY STUDIED.

Professor Ogden N. Rood, of Columbia College, communicates to the *American Journal of Science and Arts* a new method of ascertaining whether two tuning forks, for example, are in unison, or to determine the difference in the number of vibrations executed by them in a second. A short piece of fine steel wire is attached to each of the forks, and the latter are supported as shown in Fig. 1. The forks

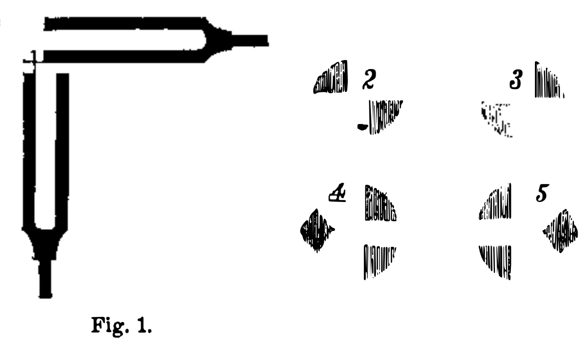

Fig. 1.

are now set in vibration, and the intersection of the wires viewed against a bright background with the aid of a small telescope. When the difference in phase is 0, an appearance like Fig. 2 is produced, which changes to Fig. 3 when the difference in phase has increased to one half a complete vibration. If the forks differ by an interval of an octave, an almost equally distinct figure will be produced, as is seen in Figs. 4 and 5, which represent the characteristic appearances in this case. Somewhat less distinct and more complicated figures are given by the quint, the duodecimo, and the double octave.

It is easy with this method to bring a vibrating string into unison with a given tuning fork, or to adjust it so that the interval shall be a quint, octave, twelfth, or double octave, above or below. It is also easy to ascertain the number of vibrations made by a string in a given case, by the aid of a bridge and a properly selected fork making a known number of vibrations, the string being shortened till it furnishes one of the above mentioned figures, and executes hence a known number of vibrations, after which the number of vibrations made by its whole length can readily be calculated by a well known law.

To bring two cords into unison, or to produce one of the above mentioned intervals, a cork cut at an angle of 45° is placed between the strings on the monochord, and, supported at this angle, is a small piece of looking glass of good quality. The reflected and vertical image of the farther string was then seen in the telescope crossed by the horizontal image of the nearer string; and the mirror being turned so as to reflect, at the same time, light from the sky, all the conditions were fulfilled.

Rods or bars, supported at one extremity or at two nodes, and provided with fine terminal wires, can by this method be brought into unison, or have one of the above mentioned intervals established between them. A preferable mode, however, is to study them in connection with the monochord and a tuning fork. The entire string of the monochord is first brought into unison with a tuning fork, or some definite interval established; the cord and rod or bar are then combined at right angles, and the bridge moved till unison is again effected, when it is possible to calculate the number of vibrations actually executed by the bar or plate. If the fine wire is attached to one side of a bell, the number of vibrations executed by the bell can readily be obtained with the monochord in the manner already indicated.

Vibrating membranes can readily be studied in this way by attaching to them a small piece of fine wire bent with two right angles, and using them in connection with the monochord or a tuning fork.

The more important of these figures may be easily rendered visible to a large audience. Wires about a milimeter thick are attached to two tuning forks placed in front of a magic lantern; an image is formed on the screen with the aid of a lens of about 0·315 inch focal length; the figures are then well shown, along with certain of their details not particularly mentioned in this article.

Great Expositions.

A correspondent of the New York *Tribune* writes from Vienna that the loss of the Austrian government, in its outlays on the recent Great Exposition of 1873, was nine millions of dollars. We have heretofore chronicled the recent suspension of the series of annual World's Expositions, which were inaugurated by the Exhibition Commission in London, and intended to continue until 1876. The losses were so heavy that the Commission was obliged to discontinue them. In view of facts like these, the American people may congratulate themselves that Congress, at its last session, refused to authorize the squandering of public money on the Centennial Exhibition at Philadelphia. The truth is that this Great Exposition business has "played out." It has ceased to be an attraction for the masses, and is chiefly useful for the advertising purposes of enterprizing dealers.

C. H. C. suggests that telegraph companies plant trees on which to hang their wires. "In most sections of the country, the tree first planted would cost but little more than a pole, and after two or three years in growth would be a permanent pole which not rot at the bottom or need resetting, and would be seldom struck by lightning. Having many times seen from three to a dozen poles, in a row, shivered by a charge of electricity running along the wires, the above question arose in my mind."

Pittsburgh Manufacturers for 1873.

Some weeks since, the Pittsburgh *Dispatch* of this city published a list of sales of houses in Pittsburgh doing a business of over $50,000 a year. The list was very imperfect; but as it is so difficult to get statistics in Pittsburgh we have compiled from this list, which was copied from the assessor's list, the items relating to our iron, steel, copper, and glass industries, believing that, imperfect as they are, they will be of value. We do not give the totals of each industry, as this would by no means give the volume of business. We would also say that none of the Allegheny manufacturers are included in this.

In the entire list there are but two houses outside of those connected with the industries given below that did a business of over $1,000,000. As will be seen, three houses in the iron or steel business did above this sum, namely: Jones & Laughlins, J. Painter & Sons, and Hussey, Wells & Co.

IRON.

Graff, Bennett & Co	$914,700	Lloyd & Black	$540,400
J. Painter & Sons	1,439,600	Zug & Co	704,690
Chess, Smyth & Co	625,400	Shoenberger & Co	740,000
Jones & Laughlins	2,750,000	Wm. Clark & Co	431 900
Brown & Co.*	793,500	McKnight, Duncan & Co	527,200
Everson, Graff & Macrum	425,000	Dilworth, Porter & Co	393,000

* Including steel.

STEEL.

Singer, Nimick & Co	$879,600	Park, Bro. & Co	$468,500
Anderson & Woods	917,300	Pittsburgh Steel Casting Co	87,500
Hussey, Wells & Co	1,150,000	Miller, Barr & Parkin	589,000

GLASS.

Bryce, Walker & Co	$166,000	Thos Wightman & Co	$300 000
Campbell, Jones & Co	72,300	Dithridge & Co	152,600
McKee Bros.	230,500	Glass, Nelley & Co	451,400
S McKee & Co	188,000	Crystal Glass Co	92,600
R C. Schmertz & Co	112,200	Atterbury & Co	168,800
Duff & Campbell	104,500	Adams & Co	121 800
Excelsior Flint Glass Co	125,900	Bakewell, Pears & Co	150 000
Keystone Flint Glass Co	103,100	Challoner, Hoglan & Co	168,100
Knox, Kim & Co	67,700	Geo. Duncan & Sons	98,500
Jas. B. Lyon & Co	119,400	King, Son & Co	166,800
Wm. McCully & Co	486,100	Dorrington Bros	81,800
Wolfe, Howard & Co	100,000		

MISCELLANEOUS.

Brenneman & Wallack, boilers	$ 53,200
A. Hartupee & Co., engines, etc	326 000
Wm. Miller, forge	140,900
W. G. Price, Sr., foundery	68,600
N. Snyder & Co., boilers	108,800
W. P. Townsend & Co., rivets	185,000
A. Bradley & Co., stoves	74,200
De Haven & Sons, stoves	76,000
Evans, Dalzell & Co., pipes	624 000
W. Graff & Co., pipes	178,400
Jacobus & Nimick Manufacturing Co., novelty goods	173,100
Park & Co., copper	189,300
Graff, Hugus & Co., stoves	150,000
C. G. Hussey & Co., copper	595,000
Mitchell, Stevenson & Co., stoves	175 000
Marshall Bros., machinery	56,000
Bissell & Co., stoves	113,000
A. Garrison & Co., founders	279 600
John B. Herron & Co., stoves	59,400
L. Peterson, Jr. & Co., founders	86 300
Alex. Speer & Sons, plows	150,500
Jos Marshall & Co., founders	140,000
Dickson, Marshall & Co., founders	78,600
A. French & Co., springs	366,600
McConway, Torley & Co., malleable iron	68,000
Totten & Co., founders	321,100
Schaal, Hoeveler & Co., boilers	93,700
Klein, Logan & Co., tools	60,800
Lewis & Rossiter, founders	90,000

—*American Manufacturer & Iron World*, Pittsburgh.

NEW BOOKS AND PUBLICATIONS.

THE AMERICAN GARDEN, a Monthly Illustrated Journal devoted to Garden Art. Edited by James Hogg. Terms $2 a year. Brooklyn, N. Y.: Beach, Son, & Co., 76 Fulton street.

This excellent journal is now in its third year, and the issue for September, 1874, commences a new series. It has been placed under the editorship of Mr. James Hogg, whose renown as a gardener and as a writer on his art, in its many and varied aspects, is widely extended. We predict an extended circulation for this periodical, under the new management.

TITUSVILLE, OIL CITY, AND FRANKLIN DIRECTORY FOR 1874. Compiled by J. H. Lant, Titusville, Pa.

Recent American and Foreign Patents.

Improved Construction of the After Hulls of Yachts, etc.

Empson E. Middleton, Southampton, England.—This invention has for its object to increase the capacity of vessels for carrying cargo or ballast, to enable them to carry more canvas to improve their sailing qualities, and to make them safer in rough weather and in heavy gales of wind. The invention consists in the arrangement of the stern post of yachts and other vessels with its lower end inclined to the rearward at an angle of 45°, more or less, in connection with a corresponding rearward extension of the keel.

Improved Saw Gummer.

Jason W. Mixter, Templeton, Mass.—As gumming machines have been heretofore constructed, the carriage ways are cast on the machine, so that the carriage and cutter cannot be adjusted to alter the direction of the cut; and the cutter being placed upon the end of the shaft, but one journal bearing and but one crank can be used. In the present device, by attaching the carriage and cutter shaft and feed screw to an adjustable "way" frame, the operator is enabled to vary the direction of the cutter so as to cut more toward the center of the saw, if desired. The cutter shaft is supported by an outer bearing on a curved arm. Two cranks may be used instead of one for operating the machine, which may be applied to either straight or circular saws, and without taking the latter from their arbors. The cutter is made detachable, so that it may be changed to adapt it to the diamete or size of the saw.