[For the Scientific American.]

## CALCULATING THE SPEED OF WHEELS, PULLEYS, ETC.

Although we are constantly solving problems as to the speed of wheels of given dimensions and the dimensions of wheels revolving at given speeds, enquiries on this subject come to us in such numbers that we cannot do better than give some plain, authoritative rules which all our mechanical readers will do well to remember:

To find the number of teeth in a gear wheel, revolving at a given speed: Multiply the speed of the driving wheel in revolutions per minute by the number of teeth it contains, and divide by the speed of the driven wheel, and the quotient is the number of teeth required. Example: If a wheel contains 50 teeth and makes 25 revolutions per minute, what number of teeth must a wheel contain to gear into the first, if it make 125 revolutions per minute? $50 \times 25 = 1250 \div 125 = 10$, the answer. For pulleys, or band wheels, the rule is the same, except that the diameter of the wheel is taken instead of the number of teeth. Example: A driving wheel is 24 inches in diameter, and makes 120 revolutions per minute; what size of pulley must be used to obtain 60 revolutions per minute? $120 \times 24 = 2880 \div 60 = 48$, the answer.

Another rule, which will answer whether we employ a single pair or two pairs of pulleys, is as follows: Divide the speed required by the speed of the driving shaft, and the quotient will be the proportion between the revolutions of the driving shaft and the revolutions required. Then take any two numbers that will, when multiplied together, give a product equal to that proportion; one of such numbers will form the relative proportion between the sizes of the first pair of pulleys, while the other number will form the relative proportion between the sizes of the other pair. Example: It is required to run a machine at 1,200 revolutions per minute, the driving shaft making 120 revolutions per minute. What sizes of pulleys should be used? $1{,}200 \div 120 = 10$. Then: $5 \times 2 = 10$, or $4 \times 2\frac{1}{2} = 10$; so that the proportion being 10 to 1, we may use two wheels of any sizes, provided that the one on the driving shaft is 10 times as large as the one on the machine. Or since $5 \times 2 = 10$, we may place on the driving shaft a pulley 5 feet diameter and belt it to one of 1 foot diameter, thus forming the proportion between the first pair of wheels of 5 to 1. The next pair of pulleys must be in the proportion of 2 to 1, that is to say, we may belt together a 2 feet and a 1 foot pulley, a 4 and a 2 feet, or any others so that one is twice as large as the other. Again, since $4 \times 2\frac{1}{2} = 10$, our first pair of pulleys may have the proportion of 4 to 1, and the second pair the proportion of $2\frac{1}{2}$ to 1, or *vice versâ*, as circumstances may require.

It is obvious that, when the speed of the driving shaft is less than the speed required, the larger pulley of each pair must be used as the driving wheels. JOSHUA ROSE.

New York city.

## SCIENTIFIC AND PRACTICAL INFORMATION.

### PURIFICATION OF COMMERCIAL CHINOIDINE.

The following method for purifying the residue, obtained as a brown resinous mass, from the mother liquor of quinine, is given by Professor J. E. De Bry, of the Hague: Dissolve 324 parts of the resinous mass in 1,670 parts of dilute sulphuric acid (1 of acid to 33 of water), heat, add caustic soda until alkaline, then add a solution of hyposulphite of soda. Three parts of chinoidine require 1 to 6 parts of soda. The dark sirupy precipitate is allowed to settle, the liquid decanted, the precipitate washed with hot water, and this wash water added to the mother liquor. The liquid is heated, and an excess of caustic soda added, when the purified alkaloid is precipitated as a white sticky substance. It is dissolved in dilute sulphuric acid and evaporated at 212° to dryness. It is very hygroscopic.

### ELECTRIC ALARM AGAINST SUFFOCATION BY ILLUMINATING GAS.

Burglar alarms have come into extended use, in this country at least, and to them have been added fire alarms, to go off when a certain temperature is reached; and it has been suggested that a suitable alarm for coal gas from leaky stoves could be added, making use of the property that carbonic oxide possesses of precipitating palladium salts. Another modification has been invented by Ansel, for detecting the escape of street gas in a room. It possesses the advantage of simplicity, and its operations depend on a physical taw, not a chemical one, namely, that the lighter a gas is the more rapidly it diffuses through a porous membrane.

The apparatus consists of a pear-shaped vessel covered with a porous membrane or unglazed earthen plate. This vessel has attached to it a U-shaped tube filled with mercury. One pole of the battery dips into the mercury, the other terminates just above the surface of the mercury in the open end of the tube. If this apparatus is placed in a room where coal gas is escaping, the gas enters through the porous plate more rapidly than the air can escape; a certain pressure is produced, which causes the mercury to rise in the open leg and complete the circuit, thus giving the alarm. It is said that a comparatively small amount of gas in a room will set the apparatus in motion. A similar apparatus with the opposite arrangement of the terminating wires could be employed for detecting a large escape of carbonic acid from any source, for this gas is so heavy as to at once produce a partial vacuum in the pear-shaped vessel, and, of course, a fall of mercury in the open leg. The amount of carbonic acid requisite to vitiate an atmosphere is, however, so small that it would probably be without effect on this instrument. There may be other cases where the pressure of gases much heavier or lighter than air could be detected more quickly by this than by the ordinary methods, as in coal mines and wells; while an advantage is that signals may be automatically conveyed to any desired distance. This seems, at least, a promising field for inventive genius and research.

### PLATINUM PHOTOGRAPHIC PRINTS.

Professor Stebbing has written an article to the *Photographisches Archiv*, extolling Willis' process of printing in platinum, which takes, he says, but one fifth as long as silver printing. A sheet of starched paper is floated on a very weak silver solution, then laid on a glass plate, and over it is poured a mixture of sesqui-oxalate of iron and platino-chloride of potassium (or sodium ?) and evenly distributed with a tuft of cotton wool. When dry, it is exposed under a negative until a weak picture is produced, the time being regulated by a photometer. It is developed on a warm solution of oxalate of potash; it is immediately removed, washed in weak oxalic acid until the whites are clear, then washed in water and toned on sulphocyanide of gold. It is finally drawn through hypo solution and well washed.

### A NEW ADULTERANT FOR SUGAR.

It having been suspected for some time at Marseilles that sugar imported thither from Réunion Island was adulterated, examinations were recently instituted by government authority. It was found that the sugar, of a light brown color, was adulterated with sand and with slag to the value of \$2.40 in every 220 lbs. The slag ground up imitated the natural sugar perfectly, while the sand served to give increased weight.

### NEW ELECTRICAL DISCOVERIES.

Professor John Trowbridge, of Harvard College, has made (1) a new induction instrument, in which the fine wire of the coil, instead of being distributed upon a single straight electromagnet, is distributed equally upon two straight electromagnets. 2. The cores of the magnets are made of bundles of fine wires. 3. The armatures are composed of thin plates of soft iron.

In his experimental instrument, the armature consisted of twenty plates of iron, each $\frac{1}{24}$ inch thick, forming an armature $1\frac{1}{4}$ inches in thickness.

Professor Trowbridge states that the use of this armature, in connection with the wire cores, increases the strength of the electric spark four hundred per cent, and also increases the length of the spark 100 per cent.

## Good Words.

The first of the following notices is taken from the Austin (Texas) *Daily State Gazette*, the other from the *Comic Monthly*, published in this city. We need hardly state that both journals express their unsolicited opinions. Both reached us at about the same time, and it seems to us a notable coincidence that two periodicals so widely separated, both geographically and in character, should substantially agree in the mode of expressing their complimentary opinions of our journals. To the editors we offer our best thanks, and we reprint the notices, not only to exhibit to our readers how general is the appreciation in which the SCIENTIFIC AMERICAN and the SUPPLEMENT are held, but also as examples of encouragement well calculated to stimulate labors, even as arduous as our own.

"The SCIENTIFIC AMERICAN is the pride and glory of the intelligent people of this country. It has done more to foster invention, encourage science, and develop the peculiar mechanical genius of our people than all other publications combined, with the Patent Office thrown in. It is the mirror of sciences and mechanic; and everything that is novel, original, and useful finds its way into its well filled columns. Each number is a perfect storehouse of knowledge. We have lots of technical works, but few practical publications. The SCIENTIFIC AMERICAN is practical. It should be in every household, for it can never do harm to any, and may be the source of many future discoveries. No artisan, farmer, or student can afford to do without it, unless willing to sacrifice the surest source of reliable scientific knowledge. Impressed with the golden opportunity afforded by the Centennial, the SCIENTIFIC AMERICAN is issuing a supplement in addition to its regular weekly number. It is distinct from the regular issue, and has a large circulation. Those who desire to keep posted should take both. The SCIENTIFIC AMERICAN proper deals with the latest inventions and mechanics generally, the SUPPLEMENT with Centennial matters, the international exhibitions of past years, chemistry and metallurgy, technology, astronomy, natural history, medicine, hygiene, etc. It is uniform in size with the SCIENTIFIC AMERICAN, for convenience in binding. The SCIENTIFIC AMERICAN can be obtained for \$3.20 per annum including postage, or both it and the SUPPLEMENT for \$7. No subscriber can fail to receive back treble this value in the course of a year, even from the practical hints they contain."

The other contemporary says:

"THE BEST IN THE WORLD.—Nothing gives a better idea of the advancement our country has made in those arts and industries which make a nation great than that well known and widely circulated weekly, the SCIENTIFIC AMERICAN. This paper gives a record of all events transpiring from week to week in invention, discovery, and industrial and mechanical arts of every description. It gives fine illustrations of all important new or improved machinery; new discoveries and processes; able critical and descriptive articles; and, indeed, a vast fund of information, scarcely obtainable in any other form at any price. The SCIENTIFIC AMERICAN has for many years occupied the front rank, not only in this country but in the world. It is, indeed, invaluable to the inventor, manufacturer, scientific investigator, and artisan, and its large circulation and high reputation attest the appreciation of the public. During this year, the SCIENTIFIC AMERICAN is specially valuable, as the Centennial is bringing into notice many machines and manufactures. The publishers have duly felt the responsibility resting upon the leading scientific journal of the world, and, in addition to their regular edition, are issuing a large and handsome extra edition which they call the SCIENTIFIC AMERICAN SUPPLEMENT. To inventors or manufacturers, whether native or foreign, who desire to reach the notion of American trade, nothing can be offered equal to the combined influence of the regular and supplementary editions of the SCIENTIFIC AMERICAN; and of both, Americans have just cause to feel proud."

## Substitute for Wrought Iron and Steel.—The New Manganese Bronze.

A correspondent of the London *Mining Journal* says that the researches of the White Metal Company of Southwark and the extensive experiments of Colonel Younghusband, of the Royal Woolwich gun factories, have established beyond question or doubt that the new alloy may be considered to be twice as strong as brass, bronze, white, or gun metal, and that it must, therefore, inevitably supersede these compounds: while compared to wrought iron, its strength is computed to be as 1,000 to 360.

The best brass we may take as being composed of 80 parts of copper and 20 of zinc, bronze as composed of 90 parts of copper and 10 of zinc. But it is found that an addition of 1 to 2 per cent of manganese (which does not increase the price) to either of these compounds, but especially the latter, not only marvelously improves the alloy, but gives us virtually a new metal. It is harder, it is tougher, it is more elastic: so much so that, while the best wrought iron reaches its elastic limit under a strain of 10 tuns, has a breaking strain of from 22 to 24 tuns, and an elongation of from 10 to 15 per cent, a forged piece of manganese bronze bore a strain of 12 tuns, a breaking strain of 30 tuns, and an elongation of 20·7, and in some instances of even 35·5, per cent. It can be forged, rolled, and otherwise manipulated at a red heat with an ease and readiness hitherto unknown; and the hardness, toughness, and elasticity appear to be easily varied, according to the mode of treatment and the proportion of manganese added. No better instance of this vast superiority can be given than that no metal or alloy could be found except phosphor bronze—to which manganese bronze is to be preferred—to bear the strain of the engines of the new vessel, the Shah, on their crank bearings, and that the vessel was practically valueless until that alloy was tried, and it alone fulfilled all the requirements. There seems to be no doubt, therefore, that the new bronze will be used for all those purposes for which copper and its alloys have been hitherto employed; for who would use brass or bronze when they can get the new metal, doubly enduring, and therefore doubly as economical, for the same price? Thus, it will be required for all bearings for engines of every description, for slide valves, pistons, etc., for boiler tubes, for locomotives, for fire boxes, for hydraulic press cylinders, and all high pressure pumps. However, it is a very handsome metal, more golden-looking when polished, and retains its luster much longer, than brass.

The most remarkable suggestion which, however, has been made with regard to it is that manganese bronze should not only be used instead of copper for sheathing vessels, but that it will ultimately take the place of wrought iron and steel for plating our war ships, its power of elongation being a great desideratum. Careful calculation proves that a bronze plate two thirds of the thickness of wrought iron can be manufactured for the same price, and it gives us a stronger resisting power at a less weight, while a plate of the same thickness would be twice as invulnerable. Not only so, but a steel or other shot striking a manganese-bronze-plated ship would not split and crack and shatter the plate into a thousand pieces, to the imminent danger of those who are fighting it, but the shot would literally have to force its way, drilling a hole, through the tough and elastic bronze, and which hole could be readily and effectually plugged. The same arguments apply in every point to the manufacture of cannons and guns of every description. And as gun metal is really bronze, if these statements are true, all cannon ought at once to be made of the new metal. In fact, its uses seem perfectly illimitable. From Colonel Younghusband downwards, all agree as to the fineness and evenness of the texture and the perfect homogeneity of the metal; while it has also been observed that the contraction in diameter when elongated is perfectly symmetrical.

As this bronze, as we have seen, must contain (say) 88 per cent of copper, 10 of tin, and 2 of manganese, it is utterly impossible to overestimate the value which such a discovery implies to the mining industries of Devon and Cornwall, which have been so long depressed. A demand for this alloy (such as we may reasonably anticipate will, after a time, arise for it, both at home and abroad, from the infinity of uses to which it may be applied) will resuscitate the copper, tin, and manganese interests, the second of which is now in an almost ruinous condition from the low price of that metal.

NEWSPAPER enterprise at the Centennial Exposition is illustrated by the fact that the publishers of the New York *Times* will print an edition of their paper on the Walter press every morning, in the Exposition building. Duplicate electrotype plates will be made, and one set will be sent over to Philadelphia at 4 o'clock every morning, from New York; and from the plates so sent, the regular morning edition of the paper will be printed. It is expected that the *Times* will thus furnish the news in Philadelphia, in advance all our other city dailies