ALLOYS FOR BELLS, GONGS, CYMBALS, ETC.

The alloy for bells, known under the name of "bell metal," is generally composed of copper 78, and tin, 22 parts; total, 100 parts. This alloy is a yellowish white color, hard, brittle, difficult to file, and with a crystallization without luster. It acquires a certain malleability when it is rapidly cooled off, whether by immediate exposure of the casting to the air, or by being dipped in water. From analysis of old bells, made by modern chemists, it has been found that the proportion of tin varied from 20 to 26 parts to 100 of copper. These bells were rarely manufactured with new or pure metals; therefore, the analyses have often shown the presence of foreign compounds useless or detrimental to their qualities, especially certain white metals, such as zinc and lead. The former metal when in small proportion, may not really prove a defect in bell metal. It has even been tried purposely in certain alloys. Indeed, although zinc neither improves the quality nor the sonorousness of the alloy, it does not act very badly, and allows of the manufacture of cheaper bells, which, however, are not so perfect as those made of copper and tin alone. It is not so with lead, which, if present—even in a very small proportion—in bell metal, will impair its sonorousness and hardness: therefore lead must be avoided at all events. We do not see any serious objection to the introduction of zinc into the bell metal, provided too much of it be not added. A small proportion of zinc renders the alloy more homogeneous, dense, fluid, and ready to acquire the tint of old bronze. It also gives a more economical metal, which explains the sensible reduction in the price of bells at present manufactured on a large scale in certain works. These manufacturers will soon crush the strolling melters, who for centuries had the monopoly of the casting of bells.

The new manufacturer of bells tries to work rationally; he analyses and experiments with various compositions, in order to apply the metals to the best advantage. In the past, on the contrary, there were no other rules than that of the thumb, and old metals were employed, such as broken kitchen utensils, spigots, tinned copper, with solder, etc., which could give but dubious results. If we add to that the want of precise data as to the proportions, the alteration by fusion of the alloys of copper and tin, etc., we must not wonder at the differences shown by the analyses of various bells. These variations were ascertained, especially during the crisis of the French revolution, when the church bells were taken for the manufacture of cannon and coins. Besides copper and tin, the presence of zinc and iron was often detected, and also, but not often, that of silver and gold. The presence of the latter was less frequent than is generally supposed. If some credulous minds at certain epochs have brought precious objects of gold and silver to be added to the bell metal, in order to gain indulgences or to make a pious offering, we must believe that the founders were smart enough to pass the valuable offerings through a less ardent fire than that of their furnaces; as, witness the celebrated bell of the belfry of Rouen, known under the name of the "silver bell," and which was believed by tradition to contain an enormous amount of silver. Its analyses, however, made by the learned chemists of the Paris mint, gave: Copper, 71; tin, 26; zinc, 1·8; and iron, 1·2; total 100·0; and not a trace of silver! As we have already said, it is difficult to preserve the ultimate proportions of bell metal; this is also true of alloys. It is therefore necessary to increase the proportion of tin if we desire that the alloy should have the composition demanded. But whatever be the excess of tin added, we can never arrive at a perfectly exact composition on account of the oxidation during the fusion, variable with the fire and shape of the furnace, and of the phenomenon of separation which takes place in the mold, if the metal has not been well stirred and properly cast.

From experiments on samples of bell metal made at different times, we have ascertained variations in the alloy from 18 to 35 parts of tin for 100 of copper, In order to counterbalance the loss of tin in the alloy, we believe that without increasing the proportion of tin, a bell metal might be composed of copper, 79; tin, 23; zinc, 6: total 108 parts. If we suppose that the fire is properly managed, and that no unforeseen accidents take place during the melting and the casting, the cast bells ought to have a ultimate composition of copper, 78; tin, 20; zinc, 2; total, 100 parts, which corresponds to a hard, tough, and slightly malleable metal, the sonorousness of which has not been sensibly changed by the presence of zinc. The quality of bells, in regard to sound, resistance, etc., also depends upon the shape and particular processes of molding and casting, outside the question of the alloy.

Zinc, and even lead, are employed in England for the casting of bells; but if the latter metal is tolerated at all, the the proportion must be exceedingly small, just enough to perfect the homogeneousness of the alloy.

Several analyses of modern English bells give, on an average, copper, 80; tin, 11; zinc, 6; and lead, 3; total 100. In old bells of the same country, an exaggeration of tin has been found, as much as 40 per cent of the alloy. These bells were exceedingly thick, and their shape was widely different from the forms recognized by our present founders.

In France also, the proportion of the white metals, such as tin and zinc, is exaggerated, especially in the alloys for hand bells, clock bells, etc. For such objects, the common alloy employed is a sort of *potin* (yellow pewter) made of copper, 55 to 60; tin, 30 to 40; zinc, 10 to 15; while the metal for gongs and cymbals is composed, on an average of copper, 75; and tin, 25; total 100. This metal is whiter, more sonorous, more brittle than bell metal, and is not so easily filed. Chinese gongs, analyzed by Mr. Darcet in 1832, have shown 78 parts of copper to 22 of tin, and a specific gravity = 8·815.

The composition for cymbals, admitted in the shops of the school of Châlons, after the experiments by Mr. Darcet, was copper, 80·5; and tin, 18·5; total 100·0. These alloys are brittle and cannot acquire the desired resistance and sonorousness, unless they are dipped into cold water after being heated up to a certain point. The alloys of copper and tin possess the property which we have already mentioned of becoming very malleable after having been brought up to a red heat and immersed in cold water. This property is made use of in the manufacture of gongs and cymbals.

These instruments, cast in a slightly loose and green sand, in order to avoid any fracture by shrinkage, are then brought up to a red heat, and dipped into water with certain precautions. After this operation they may be forged and hammered. The proper pitch is imparted to them, either by the tempering process, or by a more or less protracted hammering at certain places, or by annealing them after they have been hardened by the hammer.—*Ironmonger.*

Our Need for Artesian Wells.

Midway between the Mississippi and the Pacific lies an elevated plateau of land, over three thousand feet above the level of the sea, uninhabited and uninhabitable—the American Sahara,—six times larger in area than the six New England States. The soil is rich in every element that combines to produce vegetation; the atmosphere is pure and healthy; nothing is needed but water. For twelve hundred miles the traveller follows the westward course of the sun without the sight of grass or tree, except where some stream gives life and greenness to its narrow margin: he sees nothing in all his course but the dry, gray, sage brush, contemptuously known to miners as grease wood. This great plain is above dew point; rain is a comparative stranger; and the streams that start through the mountains, after a short fight for life, sink away into the sands of the desert. To tap these springs, uselessly sparkling in their underground darkness, it is only necessary to bore a hole not far from five hundred feet deep, and at an average expense of about five thousand dollars; and in return for this trifling outlay, the surrounding territory will be converted into the home of man.

When water can be obtained, no part of our country is more productive. Polygamous Utah presents a city whose streets gladden the eye with foliage and the ear with the ripple of water; and the population about the city raise enough for its consumption and for large sales to traveler and to outsider. The young colony of Greeley grows apace on the strength of its water, brought from afar. Whenever this can be secured, agriculture follows. To obtain this element, one man proposes to dam up the Colorado, and scatter its waters over the plain; others offer to catch the snow cold streams as they leave the base of the mountains, and distribute them among the neighboring farms. But these sources of supply would be literally but drops in the desert, compared with the great extent of waterless territory, and would be entirely local in the amount they would furnish. There is but one certain source of supply for irrigation or consumption, and that is by artesian wells.

The oldest artesian well in Europe is at Lillers, in the *Pas de Calais*, and from its mouth water has flowed uninterruptedly for seven hundred and forty-six years.

Most valuable of artesian wells—valuable not so much for its large amount of water as for its contribution to science—is that of Grenelle, in Paris. It was sunk eighteen hundred and two feet below the surface of Paris, or sixteen hundred and ninety-eight feet below the level of the sea, before it reached water. Such is the force of hydrostatic pressure, that the water is not only impelled eighteen hundred feet to the surface of the earth, but gushes upward one hundred and twenty two feet farther, supplying more than half a million of gallons a day of pure, soft water for municipal use. It has fully repaid its cost in its benefit to Paris; it has also benefitted the world and Science by proving the correctness of geological theories. The student foretells to us the inner structure of the earth before the first blow of the pick is struck, and makes known a certainty of water where the only surface signs are sterility and barrenness.

The deepest artesian well in this country, and one of the deepest in the world, sunk by the Messrs. Belcher for their sugar works near St. Louis, brings to light nearly five thousand gallons an hour; but its warm temperature of 73° Fahrenheit and its saline qualities render it unfit for most purposes.

Japanese Carved Work.

It is a somewhat remarkable fact that, in all the varieties of ornamentation applied to such materials as porcelain, textile fabrics, paper, and in pictorial illustrations generally, the Japanese never resort to shadows for the purpose of giving the effect of relief. It is a remarkable fact because, as a race, their artists are passionately fond of relief in everything, and adopt it everywhere it can be properly used. They acknowledge the great law in decorative art that flat surfaces should not appear to be relieved, but be treated as flat surfaces; and they adopt relief only where it can be properly used. When relief is wanted, the Japanese artist has countless expedients for securing it; in porcelain, he molds it from the clay, or applies it by lac; in metal work he casts it, sculps it, or beats it up; in ivory and wood, he carves it; in lacquer work, he brings it up by coat after coat of varnish; and in embroidery, he plies thread over thread with patient care until the relief is gained. Of all the carved work of the Japanese, the most wonderful and interesting are their ivories, called *netszkes*. These consist of groups of figures and animals, grotesque figures and representations, in short, of nearly every natural object in Japan, most truthfully rendered. It is quite impossible to give any idea in words of the quaint humor, the broad caricature, the intense power of expression, and the general artistic excellence which stamps every *netszke* in which the human form appears with an individuality distinct from all kinds of a kindred nature produced in other lands. A firstrate Japanese *netszke* has positively no rival. The carving of these ivories is carried to the highest degree of perfection, and its effect is frequently enhanced by the partial application of color and gilding. The Japanese are likewise skillful in wood carving, and they frequently substitute it for ivory in their small works.

Ocean Waves.

Wilkes, in 1839, made a careful measurement of waves on one occasion when the sea appeared regular and the waves of a great height. This was his method: The schooner *Seagull* was sailing in the wake of the brig *Porpoise*, and distant from her by about two waves. Their relative positions did not seem to vary, and they were sailing eight knots an hour. Casting the log from the *Porpoise*, Wilkes observed that the clip, when on the top of the nearest wave, was 380ft. distant, or one sixteenth of a mile, and the *Seagull* on the top of the next wave, twice as far, or one eighth of a mile. The time taken by a wave to come from the *Seagull* to the *Porpoise* was, on an average, thirteen seconds. This gives 26½ miles per hour for their apparent progressive motion. For observing the hight, Wilkes chose a moment when the *Seagull* was in a hollow, and the two crests were in a horizontal line with his eye, this line cutting the *Seagull's* mast at a certain hight. His observation gave 32ft. as the wave hight. Various observations have been made of wave hight. The captain and officers of the *Inconstant* on one occasion saw waves that, as they showed, must have been more than 77ft., and waves have been known to reach the top of Eddystone lighthouse, 106ft. In estimating the motion of waves, it is to be remembered that the atmosphere exercises the pressure of an elastic force of about 2,000lb. on each foot of the wave surface, and this must be added to the weight of water forming the wave. From a series of experiments made by Mr. Walker, at Plymouth, the following inferences are made:—1, The speed of waves is retarded in proportion as the water becomes shallow, and depth facilitates wave action. 2. The speed of waves does not depend on their hight. 3. The experiments made on a large scale seemed to confirm the result obtained by Mr. Scott Russell in another way—namely, that when the depth of the water becomes equal to the hight of the wave, the latter breaks and becomes a wave of translation.

Among the waves observed were some moving 46ft. per second; these were wide apart and of short hight. Their destructive effect on masonry was, nevertheless, very great, while certain other waves, which were higher and in closer succession, and moved 41·8ft. per second, were much less destructive. The effect being as the square of the velocity, we may calculate what should be the hight of waves which, moving at the rate of 41·8ft. per second, would have an equal effect with waves 27ft. in hight, and moving 46ft. per second (27ft. having been the hight of those observed to move 41·8ft. per second). Thus $41{\cdot}8^2 \times 27 = 46^2 \times x$, whence $x = 22$.

The hight of waves in the Mediterranean has been estimated by W. Smith as in general from 14ft. to 18ft.

Notes About Rats.

A gentleman, who has passed many years of his life at St. Helena, told me lately several stories about rats, so curious that I thought them worthy of record. He said that at one time the common brown rat was extremely common all over the island, in fact, a perfect pest; and to avoid its attacks his father had constructed a large store, rat proof: namely, a rat once in could not get out again. A number, however, came in with produce and goods from the ships, and bred there. Around this store were venetian blinds to the windows, and one day one of his men, when it was raining, watched a rat sitting on the venetian and putting out his tail to collect on it the drippings of water at the edge: he then withdrew it and licked it. The servant told his master, who immediately understood that the rats could get no water inside the store, and therefore directed that a butter firkin should be cut down to four or five inches, and in the top a large circular wire rat cage trap should be fixed. Several small planks were placed for the rats to get up to the entrance to the cage, which exactly fitted the firkin. No food would have induced the rats to enter the trap, but water did, and many were thus captured. There is one peculiarity with these rats, namely, their very often building or making their nests in the trees. I have in India several times found rats' nests in trees; but they have always been stolen nests, such as deserted abodes of the squirrel or sparrow; but here my friend, who is no naturalist, tells me that they construct them principally of fir spines, on the ends of the boughs some twelve or fifteen feet from the ground, in the common fir trees. The spots selected are just where the overlapping bough nearly meets the lower one. He said that all know the rats' nests, and that he had seen them fired at, when many rats were killed and fell out to the ground. He could tell me no more, and I think that, if original nests, as he held them to be, some grass must be woven in their construction, as fir spines have but little power of cohesion. The situation of these nests was worthy of notice, although there is scarcely a situation where a rat's nest has not been found.—*Science Gossip.*

THE conversion of water into vapor develops electricity.