

That Rings a Bell

Bells are among the oldest musical instruments used in human civilization, developed independently by many cultures. Named after the Anglo-Saxon word *bellan*, meaning "to bellow," bells are hollow vessels that have been made in primitive societies out of horn, glass, shell, clay, wood, or other materials of little resonance. Once civilizations began to work metals and use resonant bronze alloys, bells became much more widely used.

Dishes, pots, and staves of hammered or cast metal make a clear tone—as opposed to mere noise—when struck; the first bells modified these shapes to generate a louder or more pleasing tone. Bells, struck by an interior clapper or exterior mallet or hammer, have been found among many peoples in different parts of the world. Used as magical amulets and ceremonial instruments, bells have been reputed to dissolve storm clouds or to summon rain, to thwart demons (when worn as amulets) and to communicate with the gods. Bells have also been used as patriotic symbols and war trophies; invaders frequently silenced town bells of captured towns to emphasize their conquest.

Early metal bells began to appear in the Bronze Age, made from beaten plates with notches cut in the corners, then folded into square shapes. Prior to this, small metal plates were strung on thongs and clattered together, or pebbles were placed inside open-mouthed rattles to make loud sounds.

In his 1951 book, *Bells of All Nations*, Ernest Morris shows a photo of what is purported to be the oldest bell still in existence, found near Babylon and dating from 1000 B.C. The civilizations of Japan, Burma, India, and Egypt also began to use bells at about the same time. In China, as early as the second millennium B.C., bells were used as genuine musical instruments, made of varying sizes and arranged in sequences to make chimes. Chinese bell-making reached its pinnacle in the Chou dynasty, from 1122–221 B.C.

References to bells abound in ancient literature, from the Bible to the Greek plays of Euripides and Aristophanes, to Roman descriptions by Ovid, Strabo, Manilius, and others. King Solomon (974 to 937 B.C.) supposedly kept large gold bells on the roof of his temple "to keep the birds away." Plutarch wrote of the siege of Xanthus in Lycia (42 B.C.),

describing how the besiegers deployed bells on nets stretched across the river, which would ring if people tried to escape by swimming.

Paulinus, the bishop of Nola in Campania, Italy, is given credit for creating the modern form of the bell around A.D. 400 when he supposedly instructed workers to suspend a large copper or bronze kettle upside down from the top of the church, where it could be made to ring as a bell.

Small copper bells, similar to modern jingle bells, have been uncovered in ancient Peruvian tombs, which date to the pre-Inca era (though no earlier than about A.D. 500, the beginning of the metal age in that area).

During the Dark Ages, riveted plate bells (such as cow bells) became popular in Europe. In Ireland, copper was available, but no tin for the smelting of bronze; according to popular legend, in A.D. 450, St. Patrick showed the Irish how to make copper or iron riveted bells for use in Christian worship. In about the 8th century, bells began to be cast in Europe, primarily as a monastic craft. By the 11th century, secular bell makers traveled from town to town as cathedrals were erected; by the Renaissance, nearly all bells were made by secular craftsmen rather than monks.

The pitch of a bell varies inversely as the cube root of its weight. The shape of bells depends on the material used, the cultural environment, and the intended application, and varies from concave to convex to straight, barrel-shaped, beehive-shaped, and hemispherical. Cross sections can be square, round, rectangular, elliptical, many-sided, even lotus-shaped. Most Western bells have the characteristic "tulip" shape, which did not become commonplace until the 13th century. Beehive-shaped bells were most common in Asia, where metal rings were placed around potlike bells to add different tonal ranges.

Around the 9th century, in Europe, a metal collar was added to the design to protect the lip of the bell, which frequently cracked when repeatedly struck with the clapper. The collar evolved into a thickened area of the bell known as the "sound bow," which improves the bell's tone.

Iron, gold, silver, steel, lead, and zinc have all been used in bell manufacture, but bronze is believed to produce the

best and most consistent tone; a clean bronze alloy developed in the 1960s is considered unsurpassed in its tone value. A copper cauldron containing 80 bronze bells has been excavated in the ruins of the city Nimrud (which was destroyed by the Medes in 612 B.C.); these bells are made of a bronze alloy of ten parts copper and one part tin; the bronze alloy commonly used today is 77% copper and 23% tin.

Both the Christian and Buddhist traditions required that prayers be said while the metal was poured into the bell molds; after the casting was completed, church officials blessed the new bells.

After a bell is cast, it is removed from the mold and tuned by being placed on a lathe that shaves off metal from the inside surface at the points inside the bell where the various partial tones are produced. This is a meticulous, precise task, since removing even a few thousandths of an inch (microns) at the wrong spot can give the bell a false tone, and the only recourse is to melt the bell down and recast it.

Bell tuning was originally done by rule of thumb, but over the centuries it became a synthesis of many sciences and crafts. By the 9th century, bell makers had learned how to control pitch precisely, shaping and adjusting the thickness of their bells to produce an entire tonal series, ranging from the Upper Partials, the Octave, the Fifth, Minor Third, Strike, Prime, and Hum Tone. The strike tone—the main tone of the bell—is dependent on the thickness of the lip of the bell.

Because both the Russian Orthodox Church and some Buddhist churches believed that their bells communicated directly with the deity, they felt obligated to cast extremely large bells as a sign of authority. One of the largest bells in the world is the Bell of Mingoon in Burma, which weighs approximately 200,000 pounds (91,000 kg) and measures ~17 ft (5 m) in diameter.

In Russia, bells began to be made in the 13th century, and by the 1500s the Russians had cast bells weighing many tons. The world's largest bell, the Tsar Kolokol, was cast in 1733 and machined and tuned for two years; it weighs 193 tons (180,000 kg) and stands 19 ft (~6 m) high and 22.5 ft (~7 m) in diameter. In 1737, however, a fire destroyed its supports, and the Tsar Kolokol fell, breaking an 11-ton chunk from its side. This bell has never been rung, although in 1836 it was raised and placed on supports; the bell is so large that its interior has been used as a tiny chapel.

With the introduction of gunpowder in

the West in the 14th century, and its use in warfare, bell foundries began to use their equipment to cast cannon as well; this was ironic, since many bronze bells were melted down to provide the raw metal for the cannon.

After centuries of refinement and subtle changes in casting techniques, the next major revolution in bell making came about in the 1930s with the advent of electronics. In electromechanical bells, a small tuned metal bar or rod is struck by a miniature hammer (or clapper), and the sound is magnified with electronic amplifiers. Now many electronic bells generate the tone itself, with no actual bell in the system. Electronic bells became very popular in the 1960s and are currently used in many carillons, warning bells, and other signals.

After a long tradition of thousands of years, heavy cast-metal bells are now primarily used only for artistic purposes.

KEVIN J. ANDERSON

Further Reading

The Craft of the Bell Founder, by George Elphick (Phillimore, England, 1988).

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