Timpani: An Introspective Look

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Timpani have a very old, rich and majestic history. The timpanist is often referred to as the backbone of the orchestra. Even though the timpanist is a percussionist and the instrument is one of the building blocks of percussion repertoire, it is usually distinguished as being separate from the percussion section.

EARLY HISTORY

"Nakers, the English name by which small kettledrums of the medieval period were known, were of Arabic or Saracenic origin" (Blades, 1992, p. 223). The instruments came to Europe in the fifteenth century as cavalry instruments played on horseback by Muslims, Ottoman Turks and Mongols. "It was mainly via courts in German speaking lands that these large, mounted kettledrums spread throughout Europe" (Bowles, 1995, p. 201). In England as well as other countries throughout Europe, the ownership of kettledrums was exclusive only to royalty and nobility.

"The Imperial Guild of Trumpeters and Kettledrummers included regular members who held the rank of officers and were privileged to wear the ostrich feather of nobility in their hats" (Blades, 1992, p. 228). "Along with trumpeters, the kettledrummers belonged to this exclusive guild, a step achieved only after up to seven years of apprenticeship" (Bowles, 1995, p. 202). They were furnished horses and grooms and were forbidden to associate with other instrumentalists considered household employees of lesser rank. The performance of kettledrums was safeguarded and could only be taught by rote from one generation to another. Because of this ritual, it is believed that little written music existed for the instrument.

CONSTRUCTION

During the seventeenth century timpani were moved indoors and utilized in an orchestral setting joining trumpets, horns and oboes. Timpanists were no longer looked upon for their improvisational or elaborate playing abilities due to receiving written parts. "The true introduction of timpani took place around 1670 by way of an orchestral score into the court of orchestral and operatic ensembles, as well as in large liturgical pieces" (Bowles, 1995, p. 202).

Timpani construction remained unchanged for several centuries, except for the gradual increase of the instrument's diameter. Early construction used rope tensioning on the drumheads. Due to the requirements of maintaining constant tension on larger heads, increasing demands of rhythmic function and precise tuning, the need for screw tensioning emerged. Screws were distributed around the rim of the drum and attached to a hoop by boring down on the skin and controlling the tension of the head. The tension was at first adjusted by a dozen bolts threaded into receptacles along the sides of the drum. In 1790, the T-handle was introduced to aid the timpanist with faster tuning changes.

During the first half of the nineteenth century a number of composers wrote for three and four drums. These compositions required rapid tuning changes for the timpanist, which hand-tuned drums were not capable of handling. Due to these rapid tuning changes, a new phase in the construction of timpani took place. Timpani began to take on a new name: machine drums. "This period was an era of vitality, innovation and change in the design and manufacture of musical instruments, generally corresponding somewhat belatedly to the Industrial Revolution" (Bowles, 1995, p. 202). Inventors were working closely with metalworkers trying to develop numerous ways to rapidly change the pitch of a kettledrum. The most successful machine drums were either tuned with a master screw, rotating the kettle itself, or by use of a foot mechanism.

The Pfundt/Hoffman design and its refinements represented important innovations in a traditional design that solved the dual problems of inertia and lack of speed found in the earlier screw and gear-type mechanisms. The contribution was a single threaded crank acting upon a pivoted lever or rocker arm that controlled the armature to which the tuning rods were attached. More significant was the fact that this simple device multiplied the force transmitted to the base plate by the crank, making for a far more efficient and powerful mechanism. The Pfundt/Hoffman model was subsequently acquired by orchestras in many of the major European cities (Bowles, 1995, p. 208).

The final major addition to contemporary machine drums emerged during the later part of the nineteenth century. Carl Pittrich developed and patented the Dresden model timpani. Pittrich developed a tuning device originally manufactured to be attached to existing drums. Years later, Paul Focke in Dresden began to produce this mechanism as a complete drum assembly. Pittrich invented a foot pedal ratchet to accommodate rapid tuning changes. This mechanism was aided by using newly available steel that was lighter than iron and greater in tensile strength. The pedal was attached to a lever with a heavy club acting as a counterweight. Utilizing a bolt attached to the center of a lever, the pedal was moved up or down, raising or lowering the drum's pitch. A tuning gauge controlled by the foot pedal was added to indicate correct pitch using a pointer and adjustable markers. Also, a fine-tuning device accompanied the drum in case of changes in temperature, humidity and/or the pressure of heavy playing.

Pittrich's invention was a historical leap that ended the limitations upon the timpanist. "While other methods of mechanical tuning continued to be used, it is the Pittrich model that, with minor changes and improvements, has remained in widespread use to this day" (Bowles, 1995, p. 212).

TIMPANI HEADS

In early days, timpani heads were produced by a parchment maker, and the materials of choice were goatskin or calfskin. The chosen skin used for heads was thicker and less uniform during those early days. Additionally, the best skins were half-tanned, and the sound produced was dull and thick with a tremendous amount of overtones drowning out the fundamental pitch.

Over a century ago, the refinement of the timpani head began. Opaque, white skins began to emerge. These heads were produced by treating hides in a lime solution, smoothing them with chalk and scraping them with a pumice stone. They were then shaved and dried in the sun, making them hard and stiff. The final step of the process included rubbing the heads in brandy and garlic. By 1850, a much thinner and more translucent timpani head was produced using alum and a mechanical process. The hides were now bathed in slaked lime to loosen the hairs, and coated with a vegetable tanning material before stretching over a frame. “It was generally agreed that these thin, translucent skins produced a far better tone than their predecessors” (Bowles, 1995, p. 220).

In the 1950s, polyethylene terephthalate was used to produce plastic timpani heads. Plastic heads of today have a different tone quality, with less resonance and elasticity. Their sonority is dryer and thinner, more brittle, and the tone itself shorter in duration. The chief physical differences are that notes produced on plastic heads have a faster decay and produce more sound, or noise, at low frequencies, thus providing uneven dynamics. They are favored particularly because of their imperviousness to atmospheric changes, making them ideal for outdoor performances or environments with constantly changing humidity (Bowles, 1995, p. 221).

Lord Rayleigh, a nineteenth-century English scientist, developed a number of theories on the function of membranes (timpani heads) that are still the basis of today’s research. “He defined the theoretical membrane as a perfectly flexible and infinitely thin lamina of solid matter of uniform material and thickness, which is stretched in all directions by a tension so great as to remain sensibly unaltered during the vibrations and displacements contemplated” (Power, 1983, p. 62).

A membrane may be thought of as a two-dimensional string, in that the restoring force necessary for it to vibrate is supplied by tension applied from the edge. A membrane, like a string, can be tuned by changing its tension. One major difference between vibrations in the membrane and in the string, however, is that the mode frequencies in the ideal string are harmonics of the fundamental, but in the membrane they are not. Another difference is that in the membrane, nodal lines replace the nodes that occur along the string (Anderson, Mills and Rossing, 1982, p. 18).

Various experiments have been conducted to define the numerous nodal lines of a vibrating membrane. These lines can be seen by sprinkling sand on a drumhead while it vibrates at various frequencies using a loudspeaker. Unfortunately, the frequency tables developed only hold true for the theoretically perfect membrane. Variations of these frequencies can be drastically altered by a slight change in the resistance of air between the membrane and the bowl of the drum. Studies have concluded that a hard blow to the drumhead causes it to start at a higher frequency and decrease rapidly as the amplitude decreases. These studies have identified more than one hundred resonant frequencies between 40HZ and 500HZ by a separate mode.

TIMPANI BOWLS

Timpani bowls are produced from copper sheeting formed into a cylindrical shape and seamed with a soft brass solder. The bottom of the bowl is added and produced in the same manner as the above. After the bowl takes shape, it is then tempered by hammering. Some timpani manufacturers and performers believe hammering the timpani bowl as hard as possible produces the best tone quality.

There are three main ways in which the bowl can affect the tone quality: baffling, shape and resonance. “The baffling effect of the bowl prevents the sound vibrations from radiating around the underside of the head. By doing so, the out-of-phase vibrations from opposite sides of the head are not allowed to cancel each other" (Power, 1983, p. 63).

Henry Taylor, former timpanist of The London Symphony Orchestra, researched the effects of the bowl upon the instrument's overall tone quality. He found a sound wave will travel straight until it meets an obstruction. Once meeting an obstruction, the wave is deflected at an angle similar to the striking point of the head. Taylor ascertained that a wave with the least number of deflections is the true one to be calculated. For example, a hemispherical bowl produces a short note, with little resonance; a shallow, spherical bowl, when struck in a short *fortissimo* style, would produce a rather unsatisfying tone as well. A hemispherical bowl with straight sides will produce good tone quality through its entire range.

MALLETS

Early mallets were short with small tips, and made of wood or ivory. These mallets produced a loud, dry sound and were ideal for outdoor ceremonies performed by the mounted kettledrummer. To soften the harshness of these mallets, the tips were covered with woolen cloth, chamois or leather. In the late 1700s and early 1800s, the tips of the mallets were replaced with various sized discs covered in flannel and held in place with a screw. Along with the various sizes, there were also varying thicknesses in order to provide differing tone qualities. The wooden-ended mallets were used for a hard, dry and bright sound; leather-covered mallets were used for a softer and less succinct sound. Sponge-headed mallets, introduced by the French timpanist Jean Schneitzhoeffer, produced a very clear tone with a faster rebound. Once the use of piano felt became prominent in the production of timpani mallets, all other forms were quickly abandoned (except for wood).

For the timpanist of today, "one of the most important factors affecting the production of a quality timpani sound is the type of stick used" (Power, 1983, p. 65). Generally, the smaller, harder mallets are used for passages requiring greater rhythmic articulation. As for the large and softer mallets, they produce a rounder and richer tone.

A larger soft beater has more contact area with the membrane and is thus able to excite the lower modes of vibration. This, in effect, produces a darker and more mellow tone. With a small, hard beater, the opposite effect can be had by exciting the higher modes; this leaves the lower modes almost inaudible. The sound is also affected by the position at which the timpani head is struck. If struck near the rim, higher modes will be excited, while moving toward the center will excite the lower modes of vibration. Correspondingly, the sound would be either very bright or very dull (Power, 1983, p. 65).

TUNING AND SOUND PRODUCTION

Most modern timpani utilize a pedal-operated tensioning mechanism, with six to eight tension lugs around the rim of the drum. The pedal permits the performer to vary the tension over a range of 3:1, corresponding to an interval greater than or equal to a sixth. "A carefully tuned kettledrum is known to sound a strong principal note plus two or more harmonic overtones" (Anderson, Mills and Rossing, 1982, p. 19). There are three effects contributing to the membrane and its harmonic relationships.

The membrane vibrates in a sea of air, and the mass of this air sloshing back and forth lowers the frequencies of the principal modes of vibration; the air enclosed by the kettle has resonances of its own that will interact with the modes of the membrane having similar shapes; the stiffness of the membrane, like the stiffness of piano strings raises the frequencies of the higher overtones. Recent studies show that the first effect (air loading) is mainly responsible for establishing the harmonic relationship of kettledrum modes; the other two effects only fine-tune the frequencies, but may have a considerable effect on the rate of decay of the sound. The frequencies of the fundamental and other symmetrical modes will be raised by the stiffness of the enclosed air in the kettle (Anderson, Mills and Rossing, 1982, p. 20).

The spectrum of sound is dependent upon the point of strike, the shape and hardness of the mallet, the strength of the blow, and the position of the performer and instrument in a given room. A normal strike to the membrane produces partials with frequencies in the following ratios: 0.85:1:1.5:1.99:2.44:2.89.

It is a little surprising that the pitch of timpani corresponds to the pitch of the principal tone rather than the missing fundamental of the harmonic series, which would be an octave lower. Apparently the strengths and durations of the overtones are insufficient, compared to the principal tone, to establish the harmonic series of the missing fundamental (Anderson, Mills and Rossing, 1982, p. 22).

The performer is always faced with an uphill battle when tuning his or her instrument. "The timpanist, first of all, is trying to tune a pitch on an instrument which does not produce a clear pitch" (Power, 1983, p. 66). The inexperienced performer can easily confuse the fundamental pitch with the overtones the drum produces. An instrument that isn't properly in tune with itself will present difficulty to the most experienced timpanist. "There is a danger of confusing pitch with tone, the brighter tones which may be present at some point on the drumhead being mistaken for sharpness in pitch, while the duller sounding places may be thought flat" (Blades, 1992, p. 355).

Another difficult aspect of timpani tuning is keeping intonation relative to each drum. A common method utilized by the timpanist is sympathetic resonance. "In many tuning situations, there is a need for tuning intervals of a fifth, particularly in compositions dated before the middle of the nineteenth century" (Power, 1983, p. 66). When the timpanist has tuned a perfect fifth interval between two drums, the dominant will be heard sounding on the tonic drum. This method of sympathetic resonance can also be used for unisons and occasionally octaves.

The tuning-gauge mechanism, which is present on most modern timpani, operates by a rod attached to the pedal system of the instrument. Dependent on the position of the pedal, a pointer that is part of the rod attached to the pedal corresponds to a letter on the gauge depicting a given pitch. This method provides great ease and relieves a tremendous amount of stress and worry for the performer.

Aside from this advantage, many factors can affect the performance of tuning gauges. Three of the most common of these problems are: mechanical inconsis inherent in the mechanism; possible shifting of the head; and the inevitable rise or fall of ensemble pitch during a performance. Gauges can be used to locate the general area of a certain pitch, but fine tuning can only be accomplished with the help of a well-developed ear (Power, 1983, p. 66).

Because of the sensitivity of many electronic tuners, the timpanist has another tool to aid in keeping the drum and its gauges in tune—unfortunately not with the rest of the orchestra. The performer can take a tuner and lightly tap each lug around the instrument; therefore, the timpanist can determine whether or not the drumhead has shifted from its fundamental pitch. After the performer has determined that the pitch is balanced around the head, he or she can adjust and properly set the gauges prior to performing. During the course of a performance, the timpanist may need to adjust the gauges and/or the pitches of the timpani due to outside influences such as temperature and humidity, force of stroke due to balance within the ensemble, and shifting of pitch due to other ensemble members. All of these fine-tuning changes can only be determined and corrected by the timpanist during a given performance.

As stated previously, timpani have a very old, rich and majestic history. However, timpanists do not have a very thorough or simplistic way of study and introspection regarding the instrument. This instrument is always unpredictable—reacting differently from day to day, performer to performer, composition to composition, and so forth. For percussionists and timpanists, an introspective look at the evolution, construction and mechanics of sound production is always a must for adequate performance.

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