# Art and Performance in Oceania

Edited by Barry Craig Bernie Kernot Christopher Anderson

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# The acoustic properties of the Fijian 'slit-gongs'

17

*Rod Ewins*

Normally referred to as the drum or slit-gong of Fiji, the *lali* has a form rather like a large wooden trough carved out of a single hollowed-out log.

> The Fijian … has found out that a hollow tree on concussion produces more sound than a solid one … [and that] a hollow tree slightly open will emit more sound than a closed one … [and] a tree stripped of its bark is an improvement on one which has its bark intact. He has likewise marked the fact that some woods are superior to others in resonance. All these … discoveries in acoustics the Fijian has embodied in his lali – an instrument half-drum and half-bell. [Deane 1911]

In most villages, either one or a pair of *lali* are found, varying in length from 0.6 to 1.8 metres (2 to 6 feet) according to the seniority of the chief living in the village, and hence the relative importance of the village. They are normally situated on one side of the village green, frequently near the church, provincial administration office, or other 'official' building, often under a shady tree, or very occasionally in purpose-built shelters that have roofs but no walls. Today their use is limited to calling the faithful to worship, sending the children off to school, and occasionally announcing special village meetings. In early days, however, the *lali* and its beat were invested with great importance, and the *lali* was never beaten without some definite motive or meaning. Beats were regionally distinct and of great variety, but their significance was easily recognised by those who heard them. The most common reference in the early literature is to the heavy, ominous beat – the *derua* – which signalled the bringing into the village of corpses intended for eating. An early missionary writer, Thomas Williams (1982), described this as 'a peculiar beating of the drum, which alarmed me even before I was informed of its import'.

Large *lali* are not used to accompany dances or *meke* – for this purpose small *lali* called *lalinimeke* are made, similar in concept but usually rather long and slim, with a proportionately smaller cavity, and sometimes with no recess in their ends. Better-made versions, however, are very fair replicas of large *lali* and are made of the same timbers. Typically they are between 30 and 60 centimetres (1 and 2 feet) long. The sound they emit when struck with their little beaters is sharp and piercing but not resonant. In use they are either placed on the floor in front of, across the outstretched shins of, or in the lap of, the player. *Lalinimeke* are used together with long sticks that are beaten with shorter ones, 'stamping tubes' of bamboo, and handclapping, to create the strong rhythm that accompanies a vocal soloist and many-voiced vocal refrain.

This paper is limited to a description of the acoustic considerations employed by the makers of *lali* – in other words, why they have the form they have, what effect the different parts have, and how the makers 'tune' them during

**17.1** (Above left) Easi Qalo, master *lali*-maker of Namuka, starts the initial flattening of the top of the *vesi* log.

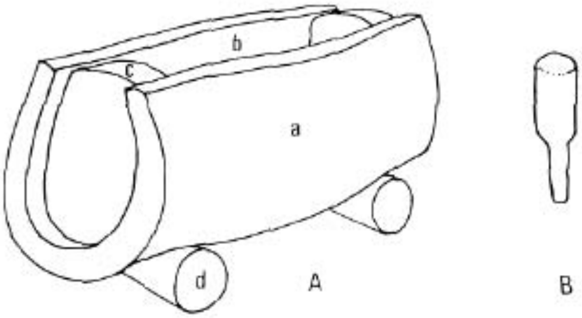
**17.2** (Above) Commencing the hollowing of the *lali*.

**17.3** (Far left) The tool kit: two felling-axes; a hollowing-adze made from a large gouge bound to a tree elbow; a chopping/planing adze made from an ancient broad-axe blade; a commercial hole-tanged adze.

**17.4** (Left) Two nearly finished large *lali* are tested for sound. More wood will be removed until the correct pitch and tone are achieved. These are *not* a matched pair of drums, which would be of disparate size. The smaller drums to 'mate' with these will be made later, about two-thirds the size of these.

manufacture. A great deal more about the process of manufacture, the traditional exchange networks in which these objects function, and their traditional uses and the various beats related to those, is provided in my 1986 article in the Fiji Museum journal *Domodomo*.

Prerogatives relating to the manufacture of important traditional goods are gender-specific and place-specific in Fiji. Making *lali* is the special male craft of the island of Namuka, in the Lau Group of eastern Fiji. During August 1985, I watched the *matai* (expert maker) Easi Qalo (pronounced Ay-ah-si Ng-ga-law) making a *lali*, from the felling of the tree to the testing of the almost-finished drum prior to final planing and sanding (figs 17.1 to 17.4). He was then aged forty-one, one of two noted *lali*-makers




**17.5** A. *Lali*: (a) belly; (b) cavity; (c) baffle; (d) roller support. B. Beater. A typical *lali* was measured as follows: L: 100 cm (max.); H: 41 cm; W: 41 cm (centre), 26 cm (ends); wall thickness: 6 cm (centre), 3 cm (ends); baffle thickness: 6 cm (top), 17 cm (bottom); extension of walls beyond baffles: 5 cm; cavity opening: 21.5 cm (max. width), 75 cm (max. length). Dimensions of beaters: L. 40 cm; head diam.: 7 cm; handle diam. 3 cm.

on the island, and his knowledge of the craft and some of his tools are a legacy from his father.

*Lali* are made only from extremely dense, acoustically resonant timbers, and today the main timber used is that of the *vesi* tree (*Intsia bijuga*, called 'greenheart' in India), which thrives in the forests of limestone islands such as Namuka. *Vesi* wood is so dense that even when dry it floats submerged to water-level. Today, chainsaws are used in the initial tree-felling and chopping-to-length. The latter is dictated by the girth of the tree, as there is an acoustically desirable proportion for the drum, and correct judgement of this is crucial to its ultimate pitch and resonance. All of the other forming is done using hand tools, axes, adzes (store-bought and homemade) and a smoothing plane. The form of the *lali* is as shown in the figure 17.5; it is open along the top, and in cross-section is bellied out between the top and the base. The side walls are slightly thicker at their centre than at the ends, and thinner at the lip than further down. A short recess is let into either end, which exactly continues the interior line of the drum wall, but is separated from the amplifying chamber by a stout straight-sided baffle, called the 'neck' or 'voice' of the drum. The chainsaw, with its round-ended bar, is an ideal tool for creating the end recess while simultaneously creating the outside face of the baffle. The projection probably affects to some degree the vibration of the walls, and thus also the soundwaves that result, but the effect is probably not great. The top edges of the baffles are in some *lali* a couple of centimetres below the level of the top of the drum wall, and sometimes are down even further below this level. On all of the Namuka ones I saw, however, the top edges of the baffles were slightly convex, starting at the walls only about a centimetre below the top edges and rising to be virtually level with them in the centre. Their height and shape would probably have some small effect on sound overtones.

There are two beaters, or drumsticks, to each drum, each with a large cylindrical head tapering sharply to the straight cylindrical handle. They must be made of wood that is much softer than the *lali* so as not to damage the lip, on the edge of which they are struck – one *lali* will outlast many beaters. They are made proportional to the size of the drum, and today are both the same size for any given drum, though interestingly this may not always have been the case. A mid-19th-century illustration (fig. 17.6), meticulously accurate in all other details, shows a drummer using a typical beater in his right hand, and a lighter one – in effect a straight stick – in his left.

**17.6** 'Feejeean Drummer', after illustration in Wilkes (1845:316).

There is a possible logic to this arrangement. Many *lali* beats require that one beater is struck much more lightly, producing a quieter and less penetrating note. The effect of a lighter stick is to produce a note similarly pitched to the heavy beater, struck with the same force, but not as loud or penetrating, and because it emphasises different overtones it has the effect of seeming to be higher-pitched also. This arrangement, therefore, would inherently provide some variation in the volume, and thus the carrying power, of the total beat, and an apparent difference in pitch at the same time. If, however, the small beater were used to strike the drum near to the baffle, then the difference in pitch would be actual, not apparent, with the overall effect of higher notes 'ornamenting' the fundamental deep note that was providing the basic rhythm.

In the following comments, I will try to show that the *lali* is not functioning as either a drum or a gong, which are the common terms applied to it. Typically in drums, a partly or wholly enclosed airspace is covered with a thin tympanum of metal, hide, or fabric. When this is struck, it is the vibration of the enclosed air that generates the sound. Gongs typically are flat plates, and while it is the material of the gong that generates the sound, as it is with the *lali*, the acoustics of flat plates are different from those in play here.

The *lali* is functioning as a wooden bell, with an open-mouthed cavity that serves to maximise the audible effect of the vibrations of its complex form. The acoustics of bells are extraordinarily complex, and even the manufacture of European and Asian cast-metal bells still relies on the maker's experience and judgement rather than scientifically definable data. Since it is the vibration of the whole object that produces the sound, virtually every variable of dimension will have some effect. Any one of these things may be modified without much noticeable effect, but the sum of them all is that which imparts to each instrument its own properties. It is in knowing how to repeatedly achieve a functional and pleasing result that the skill of the maker lies.

The *lali* is first tested for sound before final finishing. To do this it must be properly 'set up' by placing it on two short logs of coconut palm, placed at right angles to the drum and about one-quarter of the way in from either end (fig. 17.4). The use of a coil support was also noted by early observers, but I have never seen it. The vine or rope, being less dense than the palm-wood supports, and the coils creating an enclosed cavity under the drum, would probably have influenced the quality of sound, as does simply lying the *lali* on the ground without support. Ideally, for minimal interference with vibration, the supports ought to be positioned exactly under, or near to, the baffles, which are already creating a node.

Testing consists merely of beating some simple rhythms on the *lali*; if the sound is clear and penetrating it will be judged good. If the sound is muffled, since it is impossible to put material back, adjustment can be made only by judiciously carving some more out of the amplifying chamber and off the baffle, thus thinning the walls and altering the quality of the vibration when the wall is struck (changing the tone and slightly raising the pitch), and also changing slightly the distance between the walls (the nodes), thus the wavelength, and accordingly the pitch.

When it is considered acceptable, the outside is finished off with a normal smoothing plane. Formerly, I was told, it was scraped smooth with a seashell, possibly a *Conus*. Old *lali* were often as smooth inside as out, but these days there is no attempt to finish off the inside surface of the amplifying chamber beyond the rather rough 'dimpled' finish left by the hollowing adze. This must interfere to a small degree with internal reflection, and thus its amplifying effect, but is perhaps not very significant given the reduced role of the *lali* today, with less need for great carrying power.

Qalo asserted that it is incorrect to make single *lali*; they should always be in pairs – one large and deep-pitched, its mate smaller and higher-pitched. In many parts of Fiji, single *lali* are the norm in villages, probably because of their substantial cost. Many traditional beats were 'scored' for two *lali* alternating, rather than the musically more advanced concept of having them playing simultaneously in counterpoint, though some overlapping can occur. Part of the conventional wisdom handed down in such traditional crafts is the judgement of sizes and proportions; the large *lali* is always made first, and the smaller one made later 'to go with it', I was told. Thus the sound of a pair of matched drums is, in my experience, invariably very attractive to the ear. In the case of the two village *lali* in Namuka, the small one was tuned to the same note exactly one octave above that of the larger one.

To establish the relationship between the physical components of the *lali* and the sounds it generates, I questioned the maker closely, and subsequently made some very simple acoustic tests on one medium-sized *lali* and one medium-sized *lalinimeke*, both of which are the property of the Tasmanian Museum and Art Gallery. The drums were beaten and recorded in the open air, as would be the case in normal usage, rather than in an acoustically 'dead' laboratory. The sound analysis was undertaken for me by my colleague David Davies of the Physics Department, University of Tasmania, who is also a musician. The following conclusions, however, are ultimately mine, and I do not implicate Mr Davies in any errors there may be. Bearing in mind that most of us are not musicians, it may be helpful to remember that sound is the effect of vibration, transmitted through the air as waves that are perceived by the delicate mechanisms of the ear. These waves may be schematically charted as a graph, in which the wave oscillates above and below a constant line while it travels through time, and its parts can be measured.

#### Pitch, tone, and carrying power

The *frequency* is the number of times the wave oscillates in a second. In the case of solid objects being agitated (as is the case with piano strings or the walls of a bell, as here), it is affected by their length, thickness, density and tension – the thicker, longer (that is, distance between the fixed ends or *nodes*) and more dense the material, the slower it will vibrate when struck, the lower the frequency, longer the wavelength and, in sound terms, the deeper the note (or lower the *pitch*). If we strike a random piece of wood or metal, many sounds of different (and/or changing) frequencies are generated simultaneously, conflicting with one another and making what we call 'noise'. The sound generated by striking a *lali* is extremely complex, but the fundamental frequency is dominant, the vibrations reinforce one another, and thus we perceive the sound as musical.

Low-frequency waves have long wavelengths that possess more energy and decay more slowly, thus carrying further. Also, they are, unlike high-frequency waves, capable of travelling around obstacles – important in heavily forested environments. The fundamental frequency of vibration of the particular *lali* that was tested was in the mid-range, which would not have exceptional carrying power. This is consistent with its average size and function, almost certainly only as a village 'meeting' drum. Certainly it would be more than adequate for its purpose, and would be heard clearly throughout a village and the neighbouring garden and work areas, all of which would typically fall within a radius of 1.6 kilometres (1 mile). The giant *lali* of important villages in old Fiji, some of them three times this size or more, in view of the greater length between the nodes of their baffles, thicker walls, and greater volume of material altogether, delivered a far deeper note, resulting in great carrying power (reported to be more than 16 kilometres (10 miles) in a straight line).

Beaters are held further up the handle (toward the head) than might be expected. This delivers a less 'woody', more mellow, sound. For the same reason, the drum is not hit right on top of the lip but either on the inside angle of the lip nearest to, or on the top of the outside wall furthest from, the drummer. The swing used for the stroke is usually fairly long and deliberate, which makes it easier to maintain a rhythm, and to ensure that each stroke has approximately the same value as the one before, since it is momentum rather than muscular effort that controls the force with which the beater hits the drum. The beater is allowed to rebound cleanly so as not to muffle the sound. Sometimes it is allowed to 'bounce' to create a short sound, but this is only in particular 'tunes'. Striking the drum in the dead centre of its length produces the longest available wavelength and thus the deepest sound. The closer to the node that vibration is initiated, the greater the excitation of shorter wavelengths and the higher the pitch. Thus, in the test, striking near the baffle shortened the wavelength of the vibration so that the drum resonated at $B_5$, whereas striking at the centre caused it to resonate four notes lower, at $E_4$. With larger drums the difference could be greater. However, beating directly at the baffle produces little vibration other than that of wood on wood, and thus virtually no musical quality.

Any note produced by a musical instrument is accompanied simultaneously by a number of higher notes, or *harmonics* (overtones). While the fundamental note is the one picked out by the ear as the actual pitch, these harmonics either reinforce or compete with it, altering the *tone*. In manufacturing, the *wall-thickness* will affect the fundamental and the harmonics; that is to say, the actual pitch and the tone, giving the particular *timbre* of the *lali*. In essence, the thicker the wood the deeper the note, but (particularly on small or average-sized drums) thinner walls may deliver a somewhat 'brighter' and less muffled note. Thus there is a 'correct' relationship between the length of the drum (and thus the distance between the baffles) and the thickness of the walls.

The *amplitude* is the distance above and below the constant line that the wave achieves; that is, the distance of deformation of the string, bell wall, and so on. The example of a plucked string can demonstrate this graphically. If it is pulled out a long way and let go, its vibrations will be long and the sound loud. If it is pulled gently only, the vibrations will be short and the sound soft. Thus amplitude is perceived as *loudness*, but because the number of vibrations per second remains the same it does not affect pitch, or the actual note. In the case of the *lali*, this means the harder the wall is hit, the louder will be the note, but it is also a function of the size of the beater and exactly where the wall is struck so as to maximise the deformation and thus the amplitude. It is for this reason that beating is on the side or edge of the mouth of the drum rather than directly on the lip, which would cause little lateral deformation and result in a lot of wood-on-wood noise. The *cavity* has a relatively large mouth, so it does not really function as a resonating – but rather as an amplifying – chamber. It facilitates a connection of the excited air all around the vibrating walls of the drum, inside and out, and focuses and projects it, thus maximising the sound. If the mouth were more closed, although the internal resonance would favour the lower harmonics and alter the tone of the drum, its carrying power would probably be diminished rather than enhanced.

The *baffles* serve not so much to close the cavity as to provide a physical connection (even to the level of continuous xylem structure) between all parts of the opened 'cylinder', permitting very rapid transmission of the waves through all parts of the drum when it is struck. (As just indicated, the note delivered by the drum is a function of wall vibration rather than of air resonating within a chamber.) Also, since they create nodes, the distance between the baffles determines the wavelength and thus the pitch of the drum – the greater the distance between the baffles, the deeper the note or fundamental frequency of the drum. Thus during manufacture some 'tuning', say from a sharp to a natural note, may be achievable by paring off the inside of the baffle. The operative effect is on the substance of the drum rather than on the size of the internal cavity.

### Note on *lalinimeke*

Testing showed that the main characteristics of the small *lalinimeke* are surprisingly consistent with those of the large *lali*. Initial amplitude (which is perceived as loudness) is similar to that of the large drum, but decay is more rapid – to about half in 15 milliseconds as against 25 seconds in the large *lali*. Thus the sound from the *lalinimeke* is loud, but much shorter. Fundamental frequency is high – approximately 1250 Hz (the note $E^{\flat}_6$) – almost exactly two octaves higher than that of the larger drum (which was approximately 333 Hz – the note $E_4$, or E above Middle C). This relatively high pitch has little carrying power, but is perfectly adequate for its function as the rhythmic accompaniment of dances.