Tutti Stringi

A brief description of
different ways of sounding string instruments

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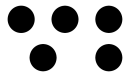

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WHAT IS A STRING?

We are thinking here of strings just in musical contexts and, chiefly, of what they are made and whether there are limits in materials to which the word 'strings' can be applied, and of how they are used.

There is one limitation in their use, and that is that they must be under tension. A slack string will produce no sound, and to sound, a string must be under tension, whether by artifice or by its nature.

But first, of what can they be made and still be called a string? Until recently, string in its normal sense was of vegetable fibre, cotton, hemp, and so on. Nowadays, plastic fibre is more common, to the detriment of the seas and lands. For musical purposes, a common quick answer would probably be animal gut, and certainly this was true in our culture, at least from Classical Greece for the lyre, up until the later Middle Ages, when other materials began to appear. Elsewhere and probably earlier, vegetable materials could be the answer and in many places these still are used, as well as other animal materials such as silk, the product of caterpillar's guts, and horsehair. Metals became common in the fifteenth century and, traditions allege, considerably earlier in some places such as Ireland, and now steel is almost ubiquitous in our orchestras, especially for violin E strings. Artificial materials such as nylon are now common over much of the world, for

they are cheap and widely available due to other purposes such as fishing, whereas natural materials need a considerable amount of work to render them usable for instruments.

It is usually thought that the oldest of string instruments was the musical bow, resonated by the player's mouth to produce the overtones of its fundamental pitch. Whether first came the archer's bow or the musician's is a matter of debate, for the string is almost everywhere tapped with a stick, and whether that stick was first the archer's arrow or was first projected by the musician at an intrusive animal, thus inspiring the arrow, we can never know. What we do know is that arrow-heads of flint first appeared in the Mesolithic period, the period between the Palæolithic and the Neolithic, from twenty to at least five or six thousand years ago in different parts of the world, and much earlier still in Africa.

What we do not know is what was the string for those earliest of bows, whether a vegetable fibre or an animal sinew or gut. Threads and strings for sewing must be a great deal earlier than the Mesolithic, and so both vegetable and animal are possible.

Because such materials do not survive from antiquity, we can only study more recent times.

Few strings, other than nylon and metal, are monofilament. We have many records, certainly from Renaissance times, and earlier from Arabic sources, that tell us how many sheep guts were twisted together to make each string of nominal pitch, and we have similar records for the strands of silk. We have less information for the strands of horse-tail hair for the early Welsh

harp, but we can see the number of strands for instruments such as the Balkan *gusle*. We are told that the Irish harp had strings of silver or gold wire. Perhaps the early harps were designed so that string length and string tension would alone cover the range (I am ignorant in this respect), but it would seem more likely that strings of different gauges were used. By the 1600s we know that some lower pitched gut strings were covered with wire to increase their mass and thus produce a lower pitch.

We know that from the late fourteenth and early fifteenth centuries good quality strings of iron and brass became available, due to higher-powered water mills, which were able to draw wire accurately through metal dies, and it was this that made our keyboard instruments possible.

All these materials: animal guts, silks, horse hairs, vegetable fibres, gold, silver, iron, and brass, are accepted as string. All have one common quality: they are cylindrical in cross-section. Is this quality an essential to define the word string?

What about West African raft zithers and the Malagasy *valiha*? These are made of light cane reeds for the zithers and thick bamboo for the *valiha*, and each has its strings raised from the cortex of the body, remaining attached to the body at each end, and raised by small blocks of gourd or, for the zithers, by a thin piece of wood running under all the strings at each end, thus putting them under tension. Many of the zither strings are, for the lower notes, wound round with strips of grass to increase their mass and lower their pitch, just as we overwind our bass piano

strings. These become cylindrical, due to the overwinding, but the higher strings remain flat in cross-section, as are the wider strings of the *valiha*.

On both these instruments, the strings are plucked by the player's fingers to produce the various pitches of the local music. Are these strings, flat in cross-section, strings?

What about those Indonesian tube zithers that have one, or sometimes, two strings, again raised from the cortex? These strings are wider than those immediately above, a quarter of inch or more in width. Some of them may have their strings plucked, but most are, like those of a dulcimer, struck with a light beater, and the instrument functions as a string drum to provide a pitched rhythm.

Even wider are the strings of those home-made zithers whose strings are made from the flat steel strips that have originally been used to strengthen packing cases. Are these strings?

Can we define a limit to the permitted width for a string to be called a string? For me, it is the purpose that counts. If they are making what we would call a string instrument, a tube zither, a dulcimer, the material and shape of the string is irrelevant. If it is a string instrument, then by definition it has strings, even if they are the rubber bands over an open box for a child's toy, even if they are metal packing strips.

THE FIDDLE BOW

A problem for many instruments is how to sustain a sound. A stroke, a pluck, and the sound dies away. To some extent the sound can be extended by a resonator, and today by electronics, but all the same, eventually the sound attenuates and dies away, unlike that of voices and wind instruments. Drums and plucked and hammered strings really suffer. Drum rolls help, but they are really only repeated strokes. Rapid repetitive plucking again are really only repeated plucks. And repeated piano notes are yet again really only repeated hammer strokes.

But all music students hear again and again from their teachers 'Make it sing'.

Drummers and keyboard players do their best, with varying success (and various improbable devices).

Plucked string players, at least, achieved limited success some time around 600-700 CE and somewhere in Central Asia, probably somewhere between the Aral and Caspian Seas. Werner Bachmann suggested (*The Origins of Bowing*) that the first attempts to produce a sustained sound on a stringed instrument was with a roughened or rosined stick, scraping it to and fro against the string. It seemed not to be long before attaching strings to the stick proved more successful, substituting friction for scraping. Since much of that area was dominated by horse-riding cultures, it cannot have been long before the 'strings' (better called

the hairs) were those from a horse's tail. By 800 CE we have references to bowed instruments in Persia and beyond.

Some of the simplest bows, still seen for example in South-East Africa, are just curved sticks, sometimes little more than twigs, with sisal threads tied to each end. The earliest representations of fiddle bows in European iconography are large, semicircular wooden bows again with string attached to each end, seen in 10th and 11th century Mozarabic manuscripts from Christian areas of Spain. And while most musical bows are sounded by tapping the string with a stick, some bows are bowed with a second bow, but whether that ever happened in prehistoric times or whether it was an adoption from European fiddling we do not know.

Those semicircular bows were large and clumsy (so were the fiddles), and a straighter stick with strings seems always to have been more successful and more popular around the world, with the nearest to Europe seen in Byzantine manuscripts of the tenth and eleventh centuries.

The problem is how to keep the hairs away from the stick. Widespread across Asia is the use of the fingers between the hair and the stick to achieve this. This has the advantage of being able to control the hair tension – by tightening the tension the hairs can rub just one string, by slackening it, the hairs can rub two or more, thus producing a drone at the same time as a melody.

In Europe and elsewhere we seem to prefer a permanent fitting between hairs and stick. This could originally have been a

forked stick, the stub of the fork serving as an attachment point for the hand-end of the stick – one sixteenth-century bow from the wreck of Henry VIII's warship Mary Rose seems to have had something like that form (see a separate article on this site for that).

We have very few surviving early bows, and what we see with them is what is called a clip-in frog. Why is this wooden block between the hairs and handle-end of the stick called a frog? Nobody seems to know, though other terms such as the heel for that end of the stick are also used. The clip-in frog is fine so long as the hairs do not stretch in use, but the only way to control any stretching of the hairs is to pull the frog a bit closer to the end of the stick and hope it will stay put. The frog also helped to curve stick slightly so as to keep the hairs a little further from the point of the bow.

A better device was the crémaillère, a ridge of notches set into the upper edge of the stick, with a bridle from the frog. This served as a ratchet – pulling the bridle into the next notch tightened the hairs without any risk of the frog slipping back. Rather later, in the mid-seventeenth century, the point of the bow began to be carved slightly, again keeping the hair further away from the point. A problem there, though, was that any thickening of the point added weight and at the same time was putting strain on the grain of the wood, risking the lower part of the point splitting away.

In the eighteenth-century Classical period somebody (there seems to be no record of who it was) had the idea of fitting a screw mechanism into the heel of the stick, with a threaded lug inset into the top of the frog and a threaded rod passing through the end of the handle. Also various devices were produced to help keep the band of hairs flattened, and also to widen the band of hairs so as to strengthen the bow stroke.

At the same time, bow makers (Cramer is always said to have been one of the first) were gradually extending the point of the stick so that the whole length of the hair could be used, though the sticks, still of snakewood and other tropical woods, were still slightly curved outwards. Various shapes of bow tip were produced under various names, each by different makers and their copyists.

Coincidentally, it was also found that wood from Brazil, which had long provided a red dye for cloth manufacturing, was of much tougher grain, with less risk of splitting, and ideal for bows. And it was also found that an inward camber of the bow stick gave much greater control and stiffness, and also that this wood, called pernambuco, would retain this camber, once it had been heated and bent to shape. Nicolas Tourte was the first to introduce this pattern, which was perfected by his son, François, though there has always been some discussion whether he or Edward Dodd was the first to introduce the inward camber.

Today a new problem has arisen and that is that pernambuco is now an endangered species. Too much has been cut down, with

no planned replanting, and as a result the use of pernambuco is likely to be banned. Whether, unlike ivory, its import or export will be prohibited seems improbable, for if it were, no orchestra, no player of any of the violin family, would ever be able to travel, for today every such player uses bows of pernambuco. But the export of new logs is likely to be prohibited, leading to a rush to find new materials for new bows. Carbon fibre has had some success, though how many professionals would adopt it we do not yet know. Certainly no other wood has yet proved popular, though early-music players have so far been able to go back to historic woods.

Musicians may be happy enough to abandon their plastic water bottles and coffee cups etc, but they are facing much greater problems for the materials of their instruments, not just their bows, but also the woods that until now have been used for clarinets and oboes, and also marimbas and xylophones. All those woods, including most of the *Dalbergias*, are now endangered species.

BRIDGES AND NUTS

The bridge is the essential link between the string/s and the soundboard of almost all the stringed instruments that have one, save for the harp. Without a bridge the sound would be weak and feeble; with it the vibration of the string is transmitted to the soundboard and then to the resonance cavity of the body.

Bridges can be fixed or free-standing. On keyboard instruments they are always fixed because they have to define the proper terminal sounding point of the string-lengths across the soundboard.

At the other end of the string, near to the tuning pins (or wrest pins), is the nut, which acts as a terminus to establish the sounding length of the string. Cristofori, the first of all piano makers, inverted the wrestplank to prevent the hammers from lifting the string off the nut – others used the agraffe, little studs fixed to the wrest plank through which the strings passed, so as to hold them firmly down.

Two forms of keyboard have no nut. One is the clavichord, where the tangent both vibrates the string and at the same acts as a temporary nut. The other is the virginals with both nut and bridge on the soundboard and because the nut is on the soundboard it also functions as a bridge and is therefore called a bridge or live-nut rather than just a nut.

Psalteries, dulcimers, and board/box zithers also have a nut at one end of the string and a bridge on the soundboard at the other end. Some have more than one bridge to cope with strings of different lengths, just as overstrung pianos do, though the psalteries and dulcimers usually have the extra bridges for the highest strings whereas overstrung pianos have them for the lowest. Also some dulcimers have arcaded or pierced bridges to allow long strings to go under one bridge and across another. On those zithers which have strings of different lengths: octaves, fifths and so on, each string or strings has its own nut near its tuning pin, with a common bridge for all the strings at the far end.

An exception is the trough zither, where strings run across the cavity of a trough-shaped body. Here the edges of the cavity of the trough act as a nut at each end, both defining the length of the string and serving to vibrate the body of the trough. Another is the æolian harp which has a nut at each end of the strings but no bridge.

And the long zithers of the Orient: the koto, kayagum, and others have a nut at one end and an individual wish-bone shaped bridge under each string, standing at the appropriate point along the length of the body for the desired pitch of each string.

A special form of bridge is used on the tromba marina and also under a special string on many hurdy-gurdies (vielles à roue). One foot of the bridge is quite wide and solid and the string passes over that end of the bridge; the other foot is lighter and vibrates

against the soundboard to add a snarl to the sound to make it resemble that of a distant trumpet.

And another special type of bridge is that of the harp-lute kora of the Manding area of the West African bulge. This bridge is high, standing on a pad on the skin soundboard of the gourd body, with a series of notches to hold strings on each side of the bridge, one string above another all the way up. The strings are attached at one end along the spike neck and at the bottom end usually to an iron ring.

Most lyres also have a bridge on the soundboard, though on those where the string goes into the soundhole, as in the Sudan for example, and through the bottom of the body to a holding bar, the string-lengths are cut off by the edge of the soundboard, which is usually then of skin, and this can be sufficient contact to obviate the need for a bridge.

Harps usually have a pin for each string on the neck to act as a nut, or a mechanism such as Erard's forchettes, and do not need a bridge since each string dives through the soundboard into the soundbox and vibrates against the soundboard as it does so.

Lutes, for which see a separate article in this series, have a wide variety of bridge types; almost all have a nut at the top of the neck. Exceptions are those such as Chinese or East African lutes that have dorsal pegs, and these usually have a loop of string round both strings and neck to act as a cut-off, though some will just use the side of the tuning peg. The string is movable along

the neck, and functions in the same way as the *capo tasto* does on our guitars.

Plucked lutes most commonly have a flat bridge glued to the soundboard since it is easy for a finger or plectrum to dip in between them and select the string it want to pluck. Bowed lutes need a higher bridge, usually curved, to allow the bow to select the string that it needs to reach, and because it is higher, with feet so small that it is not practicable to glue them to the soundboard, so it is free-standing and can be shifted to its best acoustic point. As a result it is easily lost from antique instruments and this why we depend on iconography to let us see what early violin bridges were like, though few players today use a bridge that looks like those.

We can see in mediæval iconography that many early fiddles had flat bridges because normally only one string was fingered to change its length, the others providing a drone accompaniment. One special form survived on the Welsh crwth: one foot of the bridge resting on the soundboard, and the other passing through a soundhole and resting on the inner surface of the back of the body. This made the need for an internal soundpost between soundboard and back unnecessary. We see the same thing with the Cretan lyra and a few other instruments, or its equivalent as a loose post standing in a soundhole between the back and one foot of the bridge.

With the few exceptions noted above, there is almost no string instrument in existence, save for the musical bow and its offshoot

the pluriarc, that is without a nut and/or a bridge, and even the gourd bow has a link between the bowstave and the gourd that will act as a substitute for a bridge to transmit the vibration of the string to the gourd. Only the mouthbow is without any linkage, simply being held in front of the part-open mouth of the player.

'LUTES'

A lute in terms of classification is essentially a straight, rigid stick with a resonator fixed on the end, with one or more strings running from one end to the other. At the highest level, in our culture, we have our own lute, guitar, violin, and viol, but at the lowest, whether it's our own children's improvisation or anywhere around the world, the first sentence above covers it.

Arguably, it might derive from the musical bow, the flexible bow-stave becoming straight and stiff, and the gourd resonator of the bow migrating to the end of the bow-stave, inverting so that its open end is upwards and covered by a soundboard probably of skin, and becoming fixed there.

Resonators come in all shapes, bowls, boxes, tubes, and troughs. Soundboards are usually of thin wood (hence the board of soundboard) or skin, but almost any material can be used. Necks (the stick of the above) are most commonly of wood or bamboo, but they can be round or square, curved or flat, whatever is most useful. Strings can be of string or gut, metal or fibre whether vegetable, animal, or plastic, or anything that will hold under tension. The tension is essential for otherwise the string will not sound, but any means of tension will suffice, normally adjustably so as to give the best sound and most commonly to a desired pitch.

Lutes are sounded mostly in two ways: by plucking the strings either with the fingers or by some sort of plectrum, or by rubbing the string, usually with the fibres of a bow; the fibres have been most commonly the hairs of a horse's tail, but nowadays are also often of artificial fibres.

Separate pitches are normally selected by shortening the sounding length of the string, most frequently by using a finger on the string. In our culture this is normally done by pressing the string with the fingertip firmly to the fingerboard, which lies along the neck, but others use the side of the finger or the fingernail against the string from the side, and there are others who touch the string firmly from above but without pressing it to the neck, while yet others do press it to the neck but without a fingerboard. As a special effect the string can be touched lightly at the appropriate spot: halfway, quarterway, etc along its length to encourage the string to break into proportionate lengths and so elicit overtones or harmonics. A few people, principally in Indian classical music, pull the string to increase its tension and thus raise its pitch.

The neck quite often has frets tied to it or round it or inset into it so as to give a sharper cut-off point to the length of the string. A finger alone on the neck gives a very slight fuzziness to the sound, whereas stopping the string immediately behind the fret gives the same brightness of tone of that of the open string. In our culture, violinists are often taught to avoid open strings

because their greater brightness can contrast with finger-stopped notes.

The design of lutes varies widely.

The simplest is the spike lute. Here the neck continues right through the body, emerging on the far side, with the string/s attached to the top of the neck at one end and tied to the spike at the bottom. The shape of the body is almost infinitely variable though the commonest are probably the boxes, the bowls, and often in the Orient the tubes. The soundboard is usually either wood or skin and the skin may be from almost any sort of animal, including snakes, occasionally fish, and most often something like our drumheads.

If, as suggested at the beginning of this article, the gourd bow was the origin of the lute, then it might seem probable that the spike lute was the earliest form, for passing the end of the bow-stave through the gourd would be the easiest way to secure it to the body. Certainly what early lutes that we have, for example from ancient Egypt, are spike lutes, though we cannot take them as evidence of the earliest of all. What we do know is that all the earliest lutes were plucked – the friction bow was a very late development, probably not till around 600-800 CE, so fiddles are very recent in musical invention.

The advantage of the spike over other types of neck is that there are no worries about the security of the joint between the neck and the body. Because the string/s must be tensioned, there is aways a strain on any joint between the neck and the body.

Any simple glued joint can easily come apart. Our violins in their early days had a block inside the top of the body and one or more nails hammered through that block into the end of the neck. With higher tension coming in round the end of the eighteenth century, this became unsafe and the neck was continued into the top of the body so that the neck and the block were one piece of wood and the ribs were morticed into the neck block and the top and bottom (belly and back) were glued over the ribs and the block. A spike is much simpler than that!

Spike lutes and fiddles are common over much of the world, especially in the Orient and South-East Asia, and since many of the fiddles are held downwards while sitting on the floor, the spike is useful to rest on the ground or the floor. The bowhair is often loose with its tension controlled by the fingers while playing, and in China the hair passes between the two strings, bowing up for one and down for the other. If the strings are paired, as they often are, there are then two strands of bow hair. This because the tuning pegs are dorsal so that the strings are one above the other instead of side by side.

A western African solution was the half-spike lute. Here the spike stops partway down through the body and is held in place by the skin belly which is tied by leather thongs round the back of the trough-shaped body. The body end of the spike is carved into two or more points to attach the far ends of the strings, and the upper end of the horse-hair strings is tied into loops of leather round the upper end of the neck, rather than to pegs, and the loops can be

pulled up on the neck to adjust the pitch; it looks a bit precarious but it seems to work.

Most other lutes have the neck attached to the body by whatever means seems to be secure, but there also many which are monoxyle: body and neck in one piece of wood. We see this in India, for example with the sarangi and sarinda, and it was also true in our culture with the rebec and probably with other early fiddles and plucked instruments such as the citole. This is commonest with instruments whose neck is short, but it is not easily practicable on those with long necks such as the saz and the sitar – apart from any other consideration it would waste a lot of wood and work, carving down the size of the body to that of the neck.

There is little point in going into all the manifold forms of lutes – many of them, from lutes through guitars to fiddles of all sorts are familiar to most of us, and all the rest, consisting of a neck extending from a body, will be recognised at sight whether they are the work of a master such as Stradivarius or an old oil-can with a bit of bamboo thrust through the filler hole.

The one thing that is essential for all of them is a bridge to transmit the vibration of the strings to the belly or soundboard of the instrument and thence into the resonance body beneath. Soundholes to let the resonance out are common but not essential, though their area serves to tune the airbody-resonance pitch, and frequently to please the eye, but without a bridge the belly could not vibrate and the air-body would be mute. The simplest may be a roll of the skin belly coming up against the strings, but most

commonly it is a piece of wood or other sympathetic material. Bridges can be simple or complex, for example that of the Indian sitar is very subtly rounded to encourage the string to vibrate fully.

Fiddle bridges are usually higher than plucked-string bridges simply to make it easier for the bow to select whichever string is to be sounded, whereas with a plucked string, the plectrum or the finger can select whichever string it wants. As a result, plucked-string bridges are often glued flat to the belly, whereas bowed-string bridges are more often free-standing (and therefore missing from older instruments). More details on bridges will be found in a separate article on this website.

At the other end of the string from the bridge there is usually a nut or cut-off bar at the top of the neck to give a clearly defined length of string, so that it can vibrate freely.

A common device is a tailpiece, coming between the bridge and the end of the body. This can just be a loop of string, leather, or whatever, but with multi-string instruments something that holds the strings spread out is very useful. With flat bridges and gut strings, the bridge may also serve as the tailpiece, as we see with our lute and guitar, but with wire strings the tension is usually higher and may rip the bridge from the belly, so wire strings, as with our mandolin, usually pass over the bridge to a row of pins set into the bottom of the body. With a higher bridge, certainly with a free-standing bridge, a tailpiece is better, with the strings each knotted through a hole in the tailpiece, and tailpiece tied to a tailpin set into the bottom of the body. This keeps the strings

spaced out so that each keeps its place on the bridge instead of being bunched together inaccessibly.

Among indigenous peoples around the world, before the spread of guitars and such instruments to all cultures, lutes seem to have been more common north of the Equator than to its south. There are bowed tube lutes in some eastern parts of southern Africa, but these may derive from Chinese or Indonesian influence. There were none in Australasia nor Oceania, none in the Americas, though why this should have been so I have no idea. Today, however, we see them everywhere.

LYRES, HARPS, AND LIARS

What is a harp and what is a lyre, and how do they differ?

Both are played by plucking the strings, the harp with the fingers of both hands, and the lyre either with the fingers, usually of only one hand, or with a plectrum.

Each has a soundbox, and the difference between them is how the strings run in relation to that soundbox.

The strings of the harp rise up through the belly of the soundbox, passing through the surface, which may be of wood or of skin, and are toggled below that surface or pinned to it, which is usually called the belly or soundboard. They rise up and are then fixed to the neck of the instrument, which in our instruments is called the harmonic curve. Each string is thus vertical to the plane of the soundboard, usually at somewhere around 45 degrees.

The strings of the lyre run parallel to the surface of the soundbox, passing over a bridge to a tail piece or directly to an end button at the bottom of the box, or even down through the sound hole and out through the bottom of the body to an external endbar. In that last case the edge of the belly may act as a bridge, as on some East African lyres. On some early mediæval lyres in Europe there may be a fixed tail bar, which also acts as a bridge. Each string is thus parallel with the plane of the soundboard.

The morphology of their bodies also differs. The basic shape of a harp is a (, a ⊂, an L, a <, and eventually a ◁, whereas that of a lyre is almost always a ∪.

The simplest harps seem to have been a (-shaped body resting horizontally on the base of its curve with a resonator at one end of the curve; we see these carried on the shoulder by ancient Egyptians and they survive in Central Africa today as bow harps, since they are in the shape of a bow. Also in ancient Egypt we see much larger instruments in ⊂-shape, resting on the floor with a standing or kneeling player, who is often blind. In Mesopotamia we see L-shapes on their side with the longer arm, which is the soundbox, horizontal, and in early mediæval Europe a < shape. Not until the ninth century, with the Utrecht Psalter, do we see the triangular shape with a forepillar closing the two arms of the < that we know today. This seems odd because, with any open-armed <, (, or ⊂, as one tunes one string, the arm will flex a little and will throw the other strings out of tune, whereas once we have the forepillar, the arms are held rigidly apart so that they cannot flex as the strings are tuned. The analogy is with the crocodile or shark – as it comes to bite you, if you thrust a stick vertically between its jaws, it can no longer bite your leg off. The one form in antiquity that seems to have had a forepillar is seen in the marble statuettes of the Cycladic Islands, and these remain a mystery, with allegations that they may be modern forgeries.

The original lyre, in legend, was a tortoise shell with two arms, each of horn or of wood, rising from the shell and linked at the

top by a crossbar from which strings descended across the gap between the arms to the base of the shell. Whether the belly-plate of the shell was ever the soundboard we do not know; the surviving Elgin lyre in the British Museum had a skin belly over the opening of half of the tortoise-shell, and so do all the Greek illustrations that we see. These lyres were light instruments, used to accompany songs at parties, and taught to all well-brought-up young ancient Greeks. They passed up the Nile from Hellenistic Egypt to the Meroitic culture of the Sudan and are found today all over East Africa, though with a gourd for a body instead of a tortoise shell, and in Ethiopia often with a wooden body. The larger Greek concert lyre, the *kithara*, had a wooden box-body with wooden arms, again box-shape, and can be seen on many statues of Apollo. It survived in Byzantium and was carried thence by Norsemen, through Russia, with examples in Danzig and Novgorod, into Scandinavia, and into Britain by the Anglo-Saxons, where the remains of one were discovered at Sutton Hoo, now in the British Museum. The Scandinavian lyres survived into modern times, and are being revived today, whereas the early British ones, seen in early manuscripts, were replaced by the harp in the tenth or eleventh century.

It is arguable that each, the lyre and the harp, derived from the musical bow. The (-shape harp was very close to the gourd bow, with the gourd resonator, loosely attached to the bow stave, becoming a built-on resonator. The connexion with the lyre is rather more arcane. A complex form of the musical bow is the

pluriarc, where a number of bows, each with its own string, are fixed at one end into a single resonator. If the outermost bow on each side were to become rigid, with a crossbar between them at the upper end, the strings of the inner bows could be attached to the crossbar and the inner bowstaves would then become redundant and the result would be a lyre.

Where does the liar come in? Because terminology is the trap. The old English name for the lyre was *hearpe*, and until the tenth century or so this always meant the lyre, but from then on it meant the harp. This is one reason why the Bible says that King David played the harp – he didn't, he played the lyre. And that is why Beowulf and his Anglo-Saxon contemporaries were said to play the harp – they didn't, they played the lyre.

ZITHERS TO KEYBOARDS

Zithers come in all sorts and sizes. There are sticks with one or two strings running along them, the musical bow, for example; tubes as in Madagascar with the valiha; there are rafts as in West Africa, a series of canes tied together with each cane having a strip of of its cortex lifted; there are troughs in East Africa, with the strings running across the hollow of the trough; there are even frame zithers with strings crossing an empty space, as with the Kru people and the wuj of Kafiristan; there are boards all over the place, what's probably the simplest using the ground as the board; and with sides and a bottom added below the board there are all the box zithers that are so common in our and other cultures.

The one common characteristic is that there is just the body with strings running over it, with no neck and no resonator other than the inside of the tube or the body of the box save those that are removable and still leave the zither intact.

The simplest zithers are plucked but some are struck and seem to be lateish in date, and some are operated mechanically via keyboards. One is even negatively played – with the autoharp one presses down a chord-bar and instead of that sounding the notes we want, it blocks off all the notes that we don't want.

We would presume that sticks, tubes, troughs, the ground, and maybe rafts are the earliest, but since all are made from vegetable materials, we have no archæological evidence, nor any iconogra-

phy save for some improbable and dubious Bushman paintings. We do generally assume that the musical bow is the earliest string instrument, but this is based on the presumed connexion between the archer's and the musician's use of the same bow. This is linked to the archæological evidence of flint arrow-heads which date to Mesolithic times, that period between the Upper Palæolithic and the Neolithic. Other forms of zither could well have been earlier, but we'll never know.

Nor do we have any iconography showing zithers from the ancient cultures of Mesopotamia, Egypt, Greece, and Rome. In China, however, the qin is said to go back to 3000 BCE or so and there is some iconography from around 1500 BCE. To those instruments, known as half-tube zithers, we shall return. In our own culture, iconography seems to begin in the thirteenth century with the Cantigas de Santa Maria in Spain, and there we see a large number of different shapes of box zithers, all clearly well developed by then and all of unknown earlier dates for lack of any other evidence.

These instruments, some of them related to the qanun, a name which became our canon, are typical of the Near East and Egypt. How long they had been in existence in that part of the world we do not know, simply for lack of evidence. But one of them, the so-called porco and demi-porco because of its resemblance to a pig's head, became the standard psaltery of the Middle Ages. This had its strings plucked with a quill plectrum in each hand. It was the demi-porco that later had, along its short side, a keyboard and if

we can trust the early fifteenth-century iconography, initially the earliest harpsichord was little bigger than the psaltery. But it was during that century that mills were placed on the arches of bridges where the power of the water was greatest because the arches of the bridge constricted the water-flow and thus enhanced its power. As a result of that greater power, brass and iron wire could be drawn to thinner diameters and in finer quality so that instead of two-foot instruments there could now be four-foot and even eight-foot harpsichords and clavichords, as Arnault de Zwolle describes and illustrates in his manuscript of 1440. In addition there was a rectangular instrument, the dulce melos, which was some sort of dulcimer or hammer zither which then acquired a keyboard as a form of proto-square piano, though without any sort of damper mechanism, closer to what was later called a tangenten-piano, and also the mysterious chekker.

The origins of the dulcimer are very confused. Although some of its later names, santur for example, are of ancient origin, the instrument itself is not. Mesopotamian reliefs have been misinterpreted, alleging that horizontal harps with plectra were dulcimers. There are no traces of the dulcimer in the treatises of such authorities as Al-Farabi and others in the tenth and eleventh centuries, and, with two exceptions, the earliest evidence we have comes from mediæval Europe in the mid-fifteenth century. The first of the two exceptions is said to be a Spanish relief which I have not seen and therefore cannot judge; the other is the twelfth-century ivory cover of the Melisende Psalter which is thought to

have been carved in Byzantium and is therefore three hundred years earlier than any other evidence. We see there a player with a rod in each hand and it remains a possibility that these were actually plectra and that this was a psaltery, not a dulcimer.

From the mid-fifteenth century dulcimers were widespread in Europe and remain with us today, both as common folk instruments and in the elaborated form of Schunda's Hungarian cimbalom. What is unknown is whether the dulcimer was independently invented in Persia at around the same period, using the old name of santur, or whether it was derived either from a Byzantine or European origin. Certainly it seems to have spread from Persia to other parts of Asia. And equally certainly, the Chinese dulcimer came from somewhere to its West, as is indicated by its name yangqin, which means foreign qin.

A number of zithers are rubbed, for instance some musical bows are played with a small bow, the tromba marina is bowed, the strings of the hurdy-gurdy and its predecessors the organistrum and the symphony, are rubbed by a wheel, as was the Geigenwerk, an instrument with a number of wheels and built in the shape of a harpsichord. A few box zithers in our culture are also bowed. Most other zithers are plucked (including the American mountain or Appalachian dulcimer).

Many zithers just have a row of melody strings, though some also have groups of chord strings, and occasionally drone strings for accompaniment. Many have just a few strings with a fretboard below them, with or without chord strings for accompani-

ment. Some of these, the psalmodikon for example, were used to accompany hymns and psalms sung at home.

I mentioned the Chinese qin earlier. This is one of a group of what are called half-tube zithers because the upper surface is curved and the bottom board is flat. The qin is unusual in that it has no bridges, just a row of inset spots along its length to indicate where the player should just touch the string to elicit harmonics, as well as fingering the string onto the soundboard in the usual way. The other half-tube zithers such as the Japanese koto and Korean kayagum have a wishbone-shaped bridge under each string and, as well as plucking the string, the player presses the string behind the bridge to vary the pitch. At least one type of Chinese half-tube zither is bowed. Another, common also in Japan and India as a folk instrument, is a flat box with three or four strings, and a row of keys like those of a typewriter that each raise a tangent under the strings. Properly used, the strings are plucked, but it does also work like a single-course clavichord.

In India, the vina is a stick zither with two removable gourd resonators and high-standing frets so that again the player can press on the string behind the fret to vary the pitch. Allegedly the vina is as old in its history as the qin.

The Malagasy valiha was originally a bamboo tube with, around its circumference, a series of strings raised from the cortex, the outer surface, of the bamboo. More modern versions have added wire strings with bone pegs and bridge, and there is a an interesting connexion between it and various tube zithers in

Indonesia. It is usually thought that the Indonesians brought it to Madagascar, but some authorities have suggested that the influence was the other way, and both these theories apply also to the xylophone cultures of East Africa and Indonesia and South East Asia.

One of the earliest bar or narrow box zithers in our culture is allegedly connected with Pythagoras. This was the monochord, a long, narrow, wooden box with a string, probably of gut, running along its length. There was a nut at each end of the string and there was a sliding bridge that could travel under the string to mark each pitch, which was usually named on the box. Alternatively, the string could be touched lightly at its harmonic points to provide an overtone to demonstrate the harmonic series, or the sliding bridge could be moved to mark out a scale.

This, the monochord, might be considered to be the father of all our zithers and eventually of all our keyboards.

The string was most often plucked. There were various attempts to mechanise it. One was with a wheel. The tenth- or eleventh-century organistrum, the ancestor of the hurdy-gurdy, had a series of flaps lying along its body, each of which could be turned up against the string with a handle by one player to stop the string at the appropriate points to sound a scale, while a second player cranked the wheel which rubbed the string to make it sound. It needed both players because turning the flap up needed one hand while the next required flap had to be turned up with the other hand; otherwise the open string would sound between

each pitch. Later symphonies in the fourteenth century had keys with bars that slid inwards so that a tangent on the end of each bar would stop the string at the right point along its length. Because the key at the end of the bar slid inwards and upwards and would fall back when the key was released, a single player could crank the wheel with one hand and finger the keys with the other. However, many early symphonies were shown with keys on the upper side of the box, rather than the lower side, and just how these worked is a problem, for which see a related article elsewhere on this website (Hypothesis on the Symphony).

Another attempt at mechanisation appears only in a rather later manuscript of the 1400s which shows a keyboard with long, curved shanks and tangents to stop a single pair of strings as a keyed monochord or ur-clavichord. This picture does strongly suggest that such an idea might have inspired the clavichord. The earliest clavichords, such as that in Arnault de Zwolle's treatise of around 1440, show that clavichords were built with each string being stopped by more than one key. If nobody wanted a chord of two notes a semitone or a wholetone apart, then three keys could stop the same string in succession, and if chords of a minor or major thirds were not wanted, then four or five keys could share a string. Since at this time, when Pythagorean temperament was in vogue, thirds were regarded as discords, such fretted (gebunden in German) clavichords could work; later on triple fretting and, into Bach's time, double fretting were successfully used. In many respects, the clavichord can be regarded as a set of monochords,

growing out of the use of the mechanised monochord and then the organistrum and that ur-clavichord as a teaching aid for singers.

As we have seen above, instead of using tangents to stop the string at appropriate points, Arnault also illustrates both a plucking mechanism to create the harpsichord and also a hammer mechanism, which failed to prove popular until another two and a half centuries later.

Should we think of these as string instruments or as percussion instruments? For classification purposes, they are chordophones (though for some we shall come to, see also the paper here, 'What is a String?'), but they are used to provide a pitched rhythmic drone.

I can think only of three examples, but I suspect that there are more which others can add.

The first comes from southern France and is variously called the *tambourin de Navarre* or by various onomatopoeic names such as *txun-txun* in the Basque language. It replaces the tabor, and especially the *tambourin de Provence*, both of them drums with skin heads, and, like them, is played one-handed by the pipe and tabor player. The *txun-txun* is a long wooden box with about four heavy gut strings, which are tuned to the tonic and dominant of the pipe, and it hangs from the player's shoulder. There is a bar bridge or nut at each end of the box, the upper bridge sometimes movable to act as a *capo tasto*, and that upper bridge carries metal staples that lightly touch the strings to act as brays and add a buzz to the sound. The player strikes all the strings simultaneously, with a heavy beater, to produce both a rhythm like that of the tabor, and a drone. Hence the term 'a string drum', for it is used exactly like the drum would be.

The second is peculiar to Transylvania (now mostly in Romania but previously in Hungary) and is called the *gardon*, or more strictly the *ütőgardon*. It looks like a rather roughly made cello with four strings, usually tuned to the tonic in octaves, but instead of being bowed the strings are struck with a heavy beater, like those of the *txun-txun*, and are also plucked so strongly that the string rebounds against the fingerboard. Bartók imitates this effect in some of his string quartets. Again it is used to provide a rhythmic drone. It has been suggested that the strokes with the beater and the plucks with the finger might be an imitation or replacement of the *davul*, the Ottoman drum with its heavy beater and light switch which, in its turn, is imitated by Haydn in his *Military Symphony* and by Mozart in *Il Seraglio*.

The third is a tube zither widely used in Indonesia. This a shortish length of thick bamboo internode, a foot or so long, stopped at each end by the node, with one, or more usually two strings raised from the cortex of the bamboo and bridged at each end by a fragment of gourd. The strings are often joined by a bridge or plate of bamboo, which is situated immediately above a circular soundhole cut in the body of the bamboo. The player strikes the strings, or the plate (I am uncertain which) with a light bamboo beater, usually covered with a winding of wool or other soft cord. Again it is used as a drum. Its pitch, as a drone, is controlled both by the tension of the strings and by the area of the aperture of the soundhole.

In our own culture, there is a vague reference to the string drum when the composer asks the string players to strike the strings *col legno*, with the back of the bow (thus damaging the bow's varnish and its value; most players keep a cheap old bow for when this appears in a score).

THE TRIBULATIONS OF THE VIOLIN FAMILY

As pitch standards rose from the mid-1600s towards the end of the eighteenth century, the instruments that suffered most were those of the violin family. As pitch levels rose inexorably, the strain of the string-tension rose accordingly. And to compound the resulting problems, the social changes of the late eighteenth century meant that musicians were playing in the new concert halls, instead of in the princely salons, against more, and louder, wind instruments to larger audiences. This, of course, was one of the reasons for the rise in concert pitch. A higher pitch, it was thought, would produce a more brilliant sound.

The initial change was a minor one. Composers were writing music higher, far up above the stave – Beethoven's Violin Concerto goes much higher than anything Mozart wrote in his concertos. I mentioned Beethoven, but it was probably Boccherini who led the way, climbing way up into the stratosphere of the treble clef, higher than cellists had ever met before. So the initial result was a lengthening of the fingerboard so that players could finger those notes. Fingerboards were ephemeral equipment, anyway; continual pressure of the strings on to the fingerboards created grooves and there was a limit to how much one could plane down a fingerboard without either weakening it or leave too much air between it and the strings. So fingerboards have always been re-

placed and it was little trouble to fit a longer one each time that was done.

The real problems were the string tension and the joint between the neck and the body, and also the safety of the belly. Nobody wanted to see a fiddle folding up in the middle of a concert nor to find a great crack appearing in the soundboard.

Originally violins were built with the upper surface of the neck parallel with and extending from the upper edge of the belly or the upper edge of the ribs. Because the strings rise from the nut at the bottom of the pegbox up to the top of the bridge, the fingerboard had to rise accordingly. This was achieved by inserting a shallow wooden wedge between the upper surface of the neck and the underside of the fingerboard. The neck itself was joined to the body by a block inside the top of the body, with a long iron nail or two hammered through that block into the neck.

This was the main point of weakness as string tension rose. A nail can bend and the neck can lift.

The obvious analogy of what happened next is a tug of war. If you stand upright, holding the rope against your opponents, you can too easily be pulled forward. But if you lean back, then it is far easier to take the strain. And this is what happened to the neck. It was canted back, and of course as it did so, the fingerboard rose up towards the strings, and the old wedge was no longer needed between neck and fingerboard. The neck was now morticed into the block in the top of the body, and this formed a far stronger joint than the old nails.

But still, a greater brilliance was wanted and this could be achieved by extending the neck and increasing the string tension even further. So the pegbox was sawn off the end of the neck, the old neck thrown away, and a new, longer neck was made and morticed into the block. The pegbox was spliced on to the new neck – it had been kept because connoisseurs had always admired the skills involved in carving the scroll by the great masters and the efforts made by lesser makers in copying the scroll (often in the hope of leading to a false attribution and a higher value).

String tension was now even higher – a longer neck and a higher pitch combined to threaten that the feet of the bridge could crash through the belly. It is surprising how few people have ever seen the inside of a fiddle; I used to take an unglued one to lectures and take it apart to show people. There's a variety of blocks and liners inside to hold the whole thing together. But the most important parts are the soundpost, and the bass bar that runs along the inside of belly as a supporting girder under where the bass foot of the bridge would stand. The old bass bar was quite thin and quite short, six inches or so long. The new bass bar that was now fitted to the belly was thicker and ran almost all the way along under the belly. Because the underside of the belly is curved in both dimensions, along and across, fitting the new bass bar had to be carefully done – any gaps between the two surfaces could lead to poor glueing or even to a buzz.

The sound post is a pillar that stands more or less under the treble foot of the bridge. This was also quite thin on the old set

up but the new one was almost twice as thick. It was not glued, neither to the back nor to the belly but fitted precisely between them. Fitting a soundpost is even trickier than fitting a bass bar because if it is too long it will distort or crack the belly or the back, and if it is too short it will fall down. And because its position close to the foot of the bridge is critical to the tone quality of the instrument, placing it is a matter of skill and judgement, and because as we saw with the bass bar, the belly curves in two dimensions, calculating its proper length is also critical; moving it only a couple of millimetres can mean having to adjust its length.

When did all this happen? For the violin family from around the 1780s to the 1820s. Within that period there must have been a mixture of original and modified instruments. Mozart would have heard almost all old and Spohr almost all new, while Beethoven and Weber would have heard both together.

What I have described was happening to the violin, but the same thing happened to the whole family, violas, cellos, and even basses. The result is that the fiddle family have been so altered that there is nothing left of the work of the great early masters, Amati, the Guarneri, Stradivarius, Stainer, and others, save for the box and the scroll, so much so that its maker would hardly recognise its appearance and would be astonished by the alteration of its sound.