DANIEL BETSILL

A New Musical Instrument: Creating Stockhausen's *Himmels-Tür*

A remarkable organological event occurred on 13 June 2006 at the Rossini Theatre in Lugo, Italy. That day saw the premiere of a unique instrument invented by the eminent German composer Karlheinz Stockhausen for the performance of a piece of the same name: *Himmels-Tür*, the forth composition in a series entitled *KLANG/ – Die 24 Stunde des Tages*. This article documents the instrument created for that performance, and also a second iteration of the instrument constructed by the author and redesigned on the basis of the first in collaboration with Dr Stuart Gerber, Stockhausen's percussionist, for the American debut of the piece which occurred in June 2007.

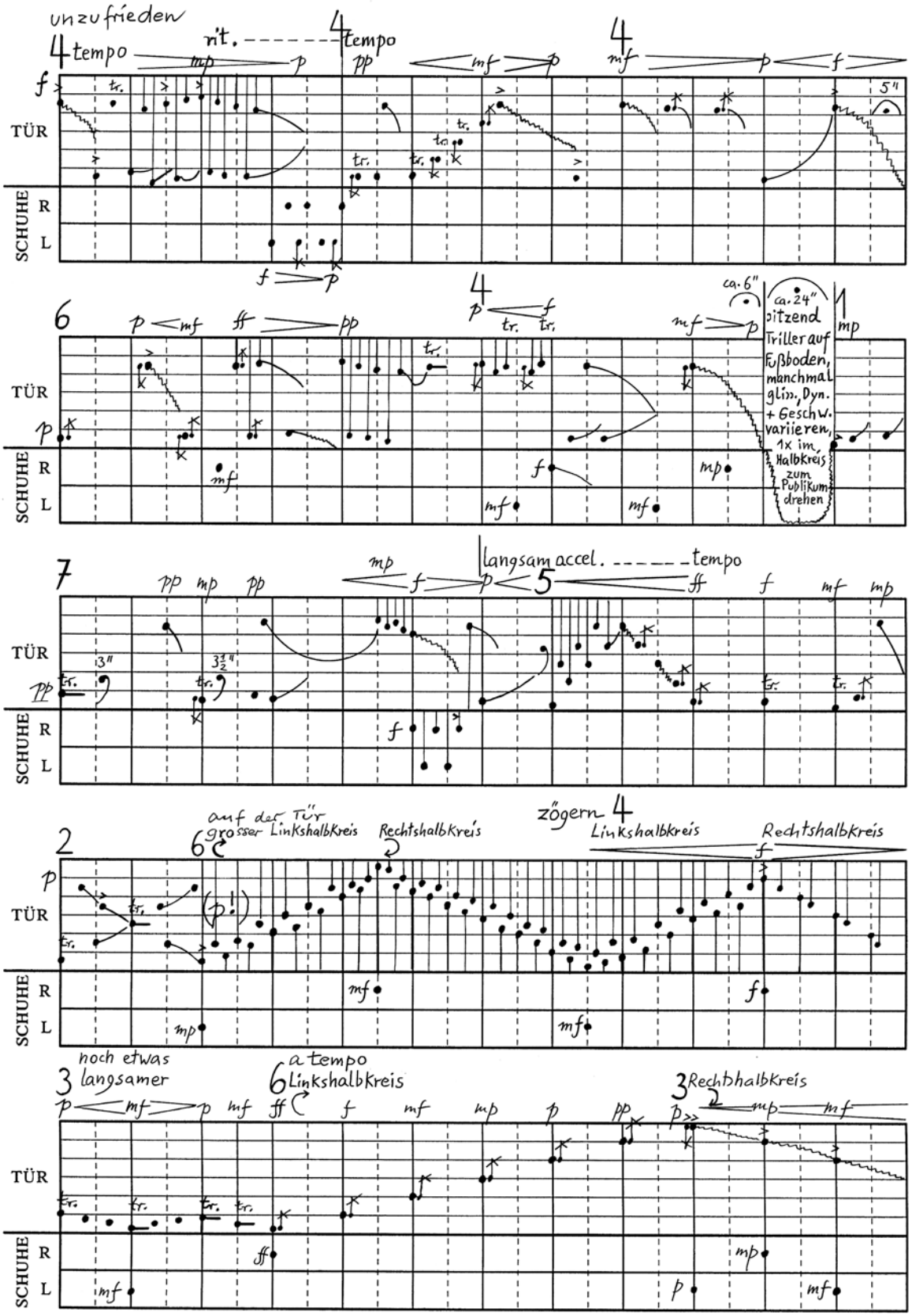
Stockhausen is known for his pioneering use of electronic instruments and indomitable presence in twentieth-century music; throughout his career he has produced compositions that require prepared versions (electronically or physically) of known instruments. However, as this particular composition required a new instrument to be built, it is a rare, if not unique, example of a major composer conceiving both composition and instrument at the same time. Indeed, the instrument was the driving force. The inspiration came to Stockhausen in a dream[1] wherein he envisioned a person standing before a large wooden double door that resembled an old church door and playing upon it in various ways to elicit entry. In the composer's words:

> A percussionist beats with wooden beaters on a heaven's door made of wood. It is divided from bottom to top in six fields. Sometimes he stomps on the floor with his nailed shoes.
>
> By knocking, beating, battering, drumming . . . he finally manages to get the door open. Nothing can be seen beyond the doorway. After a moment of silence, the percussionist cautiously steps through the doorway into the background and disappears to the left. A terrifying noise of tam-tams, hi-hats, and cymbals erupts. After a while, a siren begins to wail with slow glissandi. A little girl comes out of the audience onto the stage, walks though the doorway and can no longer be seen. The metallic noises become less frequent and gradually cease. Finally, the siren stops.[2]

The piece is scored (see Example 1) 'for a percussionist and a little girl', with no mention of the invention or the throng of percussion required for the last stage of the work. However within the liner notes of the official recording, which is intended as much to be a tutor for performers as for consumption by the listening public, the composer gives a rudimentary physical description of the instrument he had made by a local cabinetmaker. This description is repeated in the score, which also lists the other instruments. The realization of Stockhausen's dream instrument began with the surveying of actual antique doors which might be available for purchase. According to the composer, hundreds of doors were studied, with

[1] The genesis is not described by Stockhauen in any publication known to the author. My description comes from conversations with Dr. Gerber, and an interview I conducted with the composer on 6 August 2007 in the form of an email questionnaire.

[2] Karlheinz Stockhausen, *Himmels-Tür – 24 Turin*, (Stockhausen-Verlag compact disc 86, 2006).



Example 1. *Excerpt from the Himmels Tur graphic score. ©Karlheinz Stockhausen (www.stockhausen.org)*

Figure 1. *Audience-side view of the first Heaven's Door installed at the Stockhausen-Verlag. (all photographs of this Door are by Dr Stuart Gerber)*

representatives dispatched 'to check and record pitches, registers' attainable from such artifices, but with 'no useable results'. The next action was to engage in a collaborative relationship with the master carpenter Jorg Richter of Lindlar to realize a functional version of the dream instrument. The new instrument needed to combine both the physical presence indicated in the dream with the composer's specific sonic desires regarding pitch and timbre.[3] This led to the engineering of vertically mounted wooden plates on an operable structure, making the new instrument more akin to a piece of architectural woodwork than an instrument of music, which may explain why Stockhausen turned to a cabinet maker rather than to an instrument maker for collaboration. As determined by the composer's inspiration, the instrument would have 12 distinct pitches, not representing equal temperament or conventional intervals.[4]

Through experiments in collaboration with the fabricator, Stockhausen concluded that the use of different species of woods for the plates would facilitate the desired differences of pitch and it was agreed in the end that six different woods would achieve an acceptable amount of variation. The woods also produced different timbres, which Stockhausen considered an added benefit and exploited in the composition. Experimentation also solidified the method for hanging the panels which, as explained below, led the present author to desire further refinement in the construction of the second iteration of the Door.

THE FIRST HEAVEN'S DOOR

I did not have the privilege of inspecting the first Door personally, but I offer the following physical description as accurate; it is based upon the copious photographs and measurements taken by Dr. Gerber for my benefit and my many discussions with him about the operation of the instrument. As mentioned above, Stockhausen's own simplified description of the instrument may be found in the liner notes accompanying the official recording.

Figure 1 (see above and the colour section) shows a front view of the first Door. It consists of two leaves, each of six rectangular plates approximately 2 mm in thickness, held to an oak substrate framework by four bolt assemblies—one bolt at each corner of each panel—and suspended by hinges on an oak superstructure framework (in effect, the door jamb). The bolts may be seen in Figure 4, while Figure 2 shows a detail. This vertical assembly surmounts a wooden platform on which the player stands in front of the Door; the platform is hinged in half for transport. For stability, two steel angle irons are attached by through bolts in the back (visible in Figure 3).

The woods of the plates are two each of acacia (a generic term for the species that includes koa), alder, ash, oak, walnut and wenge. The plates are not made of single pieces of wood, but in all cases are edge-glued, butt-joined assemblies of smaller pieces of contrasting grain. The plates are of uniform thickness; they produce different pitches only by virtue of their densities and, it was believed by the

[3] Pitch was the primary characteristic sought from the dream. Dr. Gerber reported that as the piece was developed through rehearsals, the composer modified the composition to exploit the timbrel characteristics of the various panels. These variations were obtained through the location and type of strike made upon a particular panel and, to a lesser degree, any oddities within the grain of the wood of a given panel, such as the occurrence of a knot.

[4] Like many Stockhausen compositions, the piece requires a specialized score which graphically represents a staff unique to the piece, demonstrating the 2x6 plates of the door, repeated over the duration of the piece. The relative pitch of the plates is shown by the vertical arrangement of the notes on the tablature, not unlike guitar tablature.

Figure 2. *Detail view of the first Door bolt assembly, one bolt removed.*

Figure 3. *Dr Gerber with the first Door in rehearsal, showing one of the many playing postures described in the score.*

inventor, the slight variation in their height.[5] The lowest two panels are visibly taller than the others to facilitate playing without exaggerated stooping. All the panels are a uniform width of 98.5 cm. The machine bolts that are used in each corner to mount the panels to the framework seem to necessitate a threaded female receiver which is permanently embedded into the panel, although this is not visible to the author in the study photographs. There is a large washer approximately 2 cm thick made of some resilient material which appears to be cork; a spring separates the panel from the substrate, ostensibly to provide an anchoring point while avoiding the contact of two non-resilient materials. This effect is furthered by the full-perimeter lining of the surface of the framework that the plate would contact upon impact by felt strip which appears to rest partially in a routed channel at the inside edge of the substrate framework. The liner notes describe the plates as being 'glued vertically onto fleece', however I suspect this to be a simplified account, as it is apparent in the study photographs that the felt is glued to the framework and that the bolt assemblies were conceived to hold the panels off the felt in the dormant position. Dr Gerber recollected that the plates were indeed attached to the fleece as Stockhausen asserts, however this would seem to negate the need for springs. The most significant point to be observed about this is that the panels are fixed at their edges and not at naturally occurring nodes of vibration. The plates are arranged over their substructure in full-overlay fashion so as to completely obscure the individual leaf framework from the audience. The panels, struck by batons of maple and of pine, span a pitch range of approximately a minor third, which as mentioned, was an acceptable range for composition, working with the available woods.[6] Within each panel slight differences in pitch and timbre are affected by the type of blow and its position upon the panel. The plates were to be arranged, according to the composer's direction, in an array of pitch ascending

[5] Through later experimentation, I determined that the difference in height of these panels had no discernible impact on the pitch of the plate.

[6] The extent to which the pitches heard by Stockhausen in his dream influenced his selection of wood, and thereby in this situation, the compass, is not known.

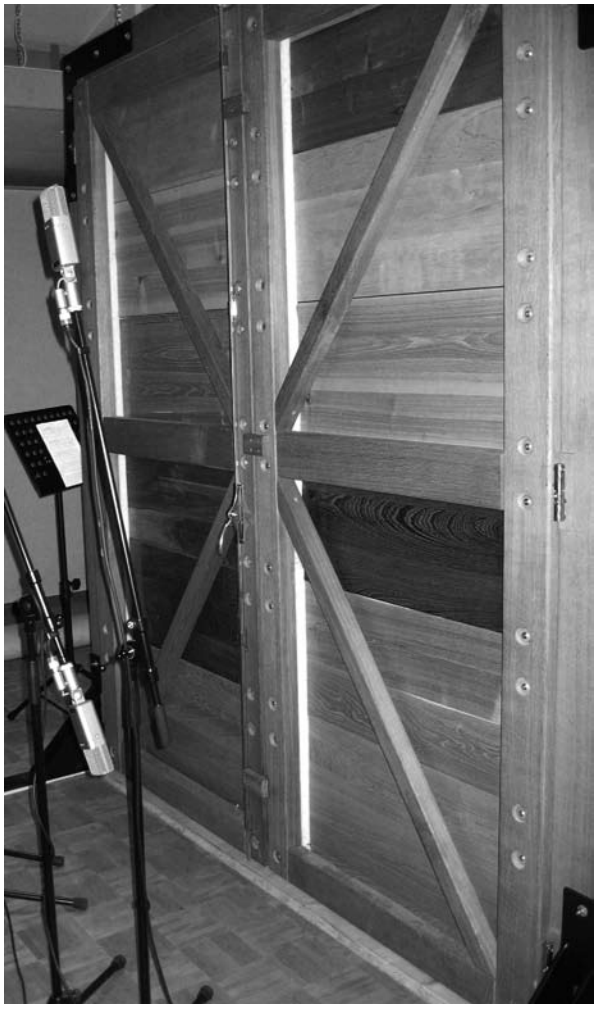


Figure 4. *Rear view of the first Door.*

from bottom to top. Initially the plates performed thus by having the species and plate heights match side-to-side. However when the plates were mounted vertically for the first time the maker found that the pitches 'moved', which necessitated the reordering of the plates and resulted in a jumbled appearance.

The substrate framework of each leaf consists of perimeter rails and stiles[7] (in which the bolt assemblies are set) with one intermediate rail braced by two diagonal struts (see Figure 4). This framework appears to be a permanent structure joined with, I assume, mortise and tenon joinery as no mechanical fasteners are visible. The leaves are attached to the superstructure with three sets of pivot hinges (see Figure 2) of a type that facilitates easy disassembly for transport. The leaves are opened manually by unseen stage hands at the appropriate time (the open state is shown in Figure 5). The doors are secured in the closed position by a lever-activated two-point jam

Figure 5. *The first Door open, showing the bracing of the leaves.*

bolt at the active leaf and three wood cleats standing proud of the surface of the frame at the passive leaf (visible in Figure 4).

The superstructure consists of two stiles attached to a single top rail by heavy steel angle plates affixed to the rear surface by bolts. The heads of the bolts are visible from the audience side. The superstructure was designed to be disassembled for easy transport. The bottom of the superstructure rails are bolted to steel angle braces that face the rear. They protrude some way beyond the front face of the frame to be received into slots in the audience-side wood platform, thus checking any splaying force of the stiles when assembled. The stiles extend the full height of the piece at 252 cm and are 15 cm wide. Separated by a top rail 197 cm in length the piece is thus approximately 227 cm wide when assembled.

The wood platform is approximately 4 cm thick and is made of two pieces joined by four flush hinges. The platform wood appears to be butt-joined pine planking glued to a plywood substrate.

A NEW HEAVEN'S DOOR

Faced with the complexities of transporting the Lugo instrument to the United States for its North American debut, and indeed in the interest of proliferation of the composition, Dr. Gerber decided to commission his own Heaven's Door from the author. Figure 6 shows the author's drawing

[7] *Stile* is the vertical structural element of a door. Any door that is panelised will have at least two stiles.

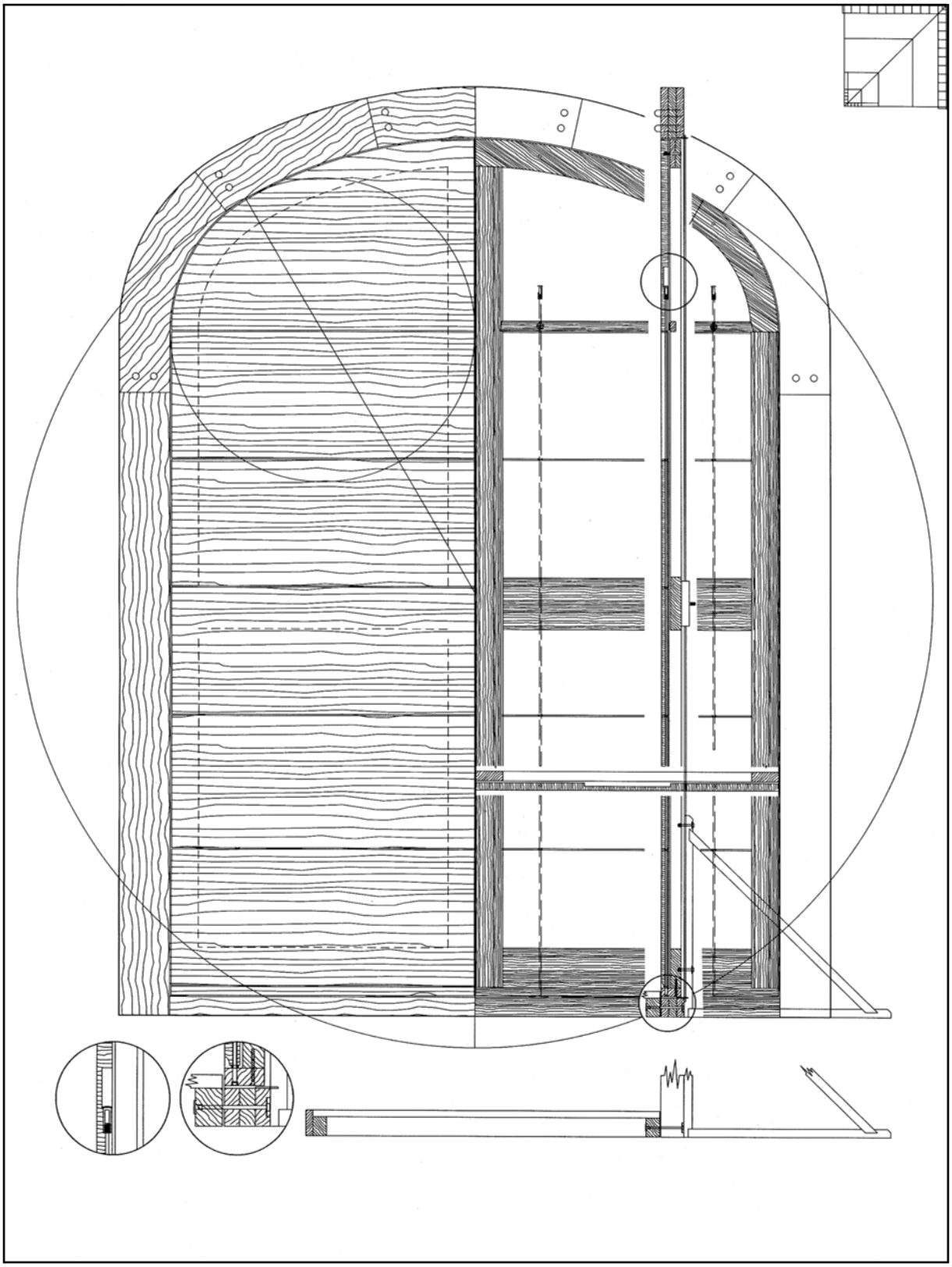


Figure 6. *The second iteration of the Door. Drawing by the author, Daniel Betsill.*

while Figures 7 and 8 (in the colour section) show the finished Door. At the onset of the project I was empowered by the instruction from the commissioner that the realization of a Stockhausen soundscape is intuitive and invites interpretation. Should this not be true for the builder as well as the performer? While observing the composer's technical requirements for the instrument as called for in the score, it was agreed by Dr. Gerber and myself that some modifications would contribute to the composer's vision. Even a cursory look at the original design raised questions for the author, who practices professionally both luthierie and architecture. I drew the following conclusions:

- The only benefit of using tone panels assembled from edge-joined pieces of contrasting grain cut as in the first Door is economy. The panels of the new instrument should be made of straight-grained quarter-sawn stock exhibiting minimal runout to promote vibratory resonance.
- The method for mounting the panels in the first Door is needlessly complicated, and actually hinders the performance of the vibrating panel. Although it seems clear that the original maker was attempting to address the need for vibratory insulation, the four laterally stationary contact points intended to accomplish that end inhibit the wood's natural propensity to flex transversely when struck; they produce a dampening effect. It may be the case that Stockhausen accepted the resultant level of resonance that he heard from the first Door. However Dr. Gerber and I agreed that resonance is desired to better realize the pitch of the plate amongst the initial noise resulting from striking a large piece of wood. Indeed, Stockhausen himself added electronic reverberation to the piece on the official recording. In turning for inspiration to a somewhat similar wooden idiophone, the marimba, I conceived a method for mounting the panels through channels situated at naturally occurring nodes of vibration. (described in detail below.)
- Were the panels to be constructed in the above manner, the need for a variety of hardwoods would be called into question, as timbre and pitch would then be adjusted rather by the thickness of the panel than by its material, so that all the panels could in fact be made of the same wood.The panel's pitch would be manipulated by relieving the thickness at the center. The issue of timbre, as suggested earlier, would be addressed in the location of the blow made by the performer upon the panel. In fact the composer manages to describe in the score these locations to produce, for example, a thinner sound towards the edges of the plate. The new design would not impede these results.
- Increasing the height of the platform, which on the first Door was merely a solid plate, to incorporate a hollow cavity would produce a sound with a more discernible pitch, and increase its volume.
- The collapsible superstructure frame should be forgone for a permanent rigid construction. I presented this idea to Dr. Gerber in the form of a comparison to an instrument such as the chitarrone: an unwieldy instrument which no less has a contiguous bass extension which does not break down for ease of transport. In our application, a superstructure that has four wooden members (rather than the three of the original: top and sides with no bottom strut), and permanently assembled, is preferable for structural reasons. The new bottom rail would be concealed by the audience-side platform, which in my version would be twice as tall as the original. The brackets for support should be of wood,[8] inclining the piece an imperceptible amount to the rear and utilizing the countering force of the now, thicker and heavier audience-side floor panel. It seems to me that the audience's perception of support should be minimized to convey an inherent supernatural rigidity. Hinges which disassemble easily are used as on the first Door. With the removal of the door leaves, the permanently joined superstructure framework is no heavier than any one of the leaves. The only hindrance to transport is that the frame retains its assembled size.[9] The frame should therefore be permanently joined with pinned mortise and tenons, with all metal frame hardware eliminated.

In addition to these acoustic and structural considerations, I suggested that, as the original conception of the instrument was analogous an

[8] The metal objects visible to the audience on the first iteration of the door, e.g. bolt heads, and to a lesser degree, the braces, were to be avoided in the new design. These elements seemed too 'Machine Age' for the author and not suggestive of the Divine.

[9] In the end this proved untenable and the author is presently in the process of modifying the superstructure of the second Door with mortise and tenon joinery so that it may be disassembled.

antique church door, it may benefit the project to make a few aesthetic changes:

- The piece could have an arched top, suggestive of the ecclesiastical
- The proportions should be adjusted to favour the vertical.[10] Should this be combined with the previous suggestion, the uppermost, curved panel would be non-playing, though attached to the operable door leaves, because of our concern that its unorthodox shape would hinder its acoustical performance and also because it would probably be out of the player's reach. This layout thereby suggested fourteen panels, rather than the twelve of the original
- The frame may be made of quartersawn white oak, stained dark to suggest age and having visible wooden pegs as is so common in antique timber frame constructions.
- The material of the panels should be more homogenous (as would be the case in an actual door), and the panels furnished with routed edge detailing more suggestive of raised panels

This last suggestion was not accepted as the edge treatment would hinder the performance of the glissandi called for in the piece. Out of courtesy, Dr Gerber informed Stockhausen of the intended modifications. The composer's only insistence was that the instrument be limited to 12 plates, corresponding to the 12 pitches of the composition. This led to the dilemma of how to utilize the uppermost curved plates as anchorage for the wire rope system yet still allow it to vibrate as the others. Several mounting scenarios were discussed, but all involved some structural member to be visible from the audience side and degrade the allusion of panels 'floating' within the superstructure.

Upon completion, the improvements anticipated were the great visual appeal of the arched top and the more acoustically-informed method for hanging the plates. The hanging system of the second Door employs two tensioned, vinyl coated wire ropes, 3/16" (4.7 mm) finished diameter, with a permanently fixed (swaged) fitting at the bottom and a similar, threaded version at the top.[11] The threaded end is

Figure 9. *Detail of the wire rope assembly showing the location of the nodal holes.*

fixed into a threaded female receiver at a rear pocket in the uppermost plate which allows for tensioning. The bottom fitting is clamped to a rail that is slightly visible at the bottom of each leaf. The entire assembly is hung from two bolts at the top edge of the uppermost panel.

Unlike the first Door which had its plates attached at the very edges, the second Door would capitalize on the natural characteristic of flex that a wood plate demonstrates when struck, that is, nodal division. After researching the equations that describe bar dimension and arch versus wood density as related to pitch for the marimba,[12] I came to appreciate that the proportions of the Heaven's Door tone plates exist independently of the influence of mathematics. Marimba equations assume a certain relationship between length, width and thickness. Our liabilities in this regard are that the Heaven's Door panels must be equal in width (the instrument is two panels wide), roughly equal in height and of a thickness that can be obtained in solid lumber of the desired species (1" (2.54 cm) thick in the case of wenge). Laminating the tone wood was considered and could be explored for future Doors: the implication being that by laminating 'cheeks' on to the back of the plate, say an extra 1" of material, the proportion of the plate would more closely resemble that of a marimba bar, in at least its thickness to its length, which were the two most important dimensions to consider for tone

[10] Although the first Door is clearly taller than it is wide, the author observed that due to the proportions, the overall impression of the front elevation is one of prostration.

[11] Similar wire rope guardrail systems are frequently employed in modern minimalist architecture.

[12] Neville H. Fletcher and Thomas D. Rossing, *The Physics of Musical Instruments*, (New York and London: Springer, 2nd ed. 1998. Corr. 5th edition, 2005), p. 264. D. Murray Campbell, Alan Greated and Arnold Myers, *Musical Instruments: History, Technology and Performance of Instruments of Western Music*, (Oxford University Press, USA; New Ed edition, 2006). p. 69.

quality and pitch.[13] In order to avoid an exponential variety of experimentation in the short amount of time available for conceiving the instrument, I determined any hypothetical improvement in tone from this method should remain outside the scope of the project. In my experiments, an adequate, if not exemplary, resonance was achieved with 1" thick material using a simple trial and error method for determining the best node location to enhance the fundamental tone. In the experiment, the plate was placed on top of two moveable, insulated sticks laid on a framework graduated about a centerline. The reverberation of the fundamental tone was timed with a stopwatch when struck. The sticks were moved in 5 mm increments (the approximate thickness of the hole to be drilled through the plate and, consequentially, the thickness of the stick) and the process repeated until the optimal resonance was established. The location of the fundamental nodes of the tone panels was found to be 256 mm from the centreline. This fundamental node is where the hole(s) for the cable was placed (Figure 9). Due to the limited pitch range required of the plates, the node location is consistent throughout.

The first Door had plates of six different varieties of wood, chosen by Stockhausen for their various densities to produce different pitches. The method for achieving pitch for the second Door was to cut relief dados of various widths on the back of each panel, similar to the method used for marimba bars. This makes the use of different woods unnecessary, however the second Door has plates made of both wenge (used in the first Door) and sapele (not used in the first Door). Dr Gerber reported that the wenge was the best sounding of the plates of the first Door, so we attempted to make all the plates of our Door with this wood, despite its liabilities of weight and cost. I was lucky to find quite a number of quarter-sawn wenge boards locally but alas not enough for the entire project. Rather than compromise and use a less-than-quartersawn cut, the decision was made to move to another wood. Quartersawn sapele with a similar density to wenge was available and was considered an acceptable substitution. The second Door therefore comprises six plates of wenge and six of sapele.

The compass for the second Door spans just over an octave. I was directed by Dr. Gerber that the guiding principal behind the pitches was the ascending

Figure 10. *A scene from the American debut performance of the Heaven's Door.*

sequence with a desire to have no recognizable intervals between panels (true thirds and fifths were avoided, for example), and that the specific intervals and overall compass were not designated by the composer. It is implicit, however, in the score that the lowest pitched plate should be the lower right-hand plate, the next to be the left-hand plate, the next to be the second lowest right-hand plate, and this alternating ascending pattern to continue to the top. One crucial component of the plate assembly on the wire rope system is the insertion of thin (approximately 4 mm) hard rubber washers between the plates at the node location. This addresses the need to separate the stacked plates from one another to ensure vibration.

Finally, the platform on which the performer stands, and often stamps, being increased in height as mentioned above, was now designed to be a resonating chamber, increasing its sound in resonance and volume. The platform, even in our iteration, has no distinct pitch, but produces a low, reverberating noise.

[13] I say this because of my own previously cited experiments where I found the height of the plate had no discernable impact on the pitch produced. As a matter of comparison, the width of a marimba bar equates to the height of the Door plates.

THE FUTURE OF THE HEAVEN'S DOOR

In the form described above, the second Heaven's Door had its debut, performed by Dr. Gerber, at the Spoleto USA festival in Charleston, South Carolina on 2 June 2007. The performer, and others who had first-hand knowledge of the first Door, reported greater resonance and, more subjectively, greater stage presence. However the performance of the upper, curved panels was noticeably subdued in comparison to the others and the author is presently engaged in modifying the rope assemblies to extend to the full height of the panel, giving, it is hoped, a greater area of unencumbered resonance. The experimental nature of this project can not be overstated. This modification aside, the performance was a great success and, judging from the audience's reaction, garnered great fascination. In comments made to Dr. Gerber some time after the performance, Stockhausen reported satisfaction with our 'interpretation'.

Shortly after the Lugo performance Stockhausen wrote a second piece for the Door, *24 Turin fur Tur, Rin, and Speaker*, which is included on the *Himmels Tur* disc and was written, apparently, as a sort of compositional footnote to unify the sound of the Door's 2x12 beats in the composition with the 24 days represented in the series title. This is the only other composition written for the Heaven's Door to date. It is well known that repetition was an anathema to Stockhausen. When asked if he intended to write further compositions for the Heaven's Door he succinctly responded that he has no intention of doing so, 'not before [he has] another dream knocking at the HEAVEN's DOOR [composer's caps]'. It is certain, though, that further performances of the piece *Heaven's Door* will be given, and indeed that further iterations of the instrument will be created by individuals wishing to perform the piece in their locale.[14] And as one keenly interested in the proliferation of this new instrument, I raise the question: is it not possible that the instrument Heaven's Door might be separated from the composition of the same name and in the hands of a new composer be put to new creative use? The Charleston instrument has already garnered notice by local composers. What if the instrument were to be fashioned with further subdivision of plates? What other subjects for composition might be conjured before the Door? It could be stated that percussion is, above all types of instruments, a physically gratifying experience: and this instrument clearly offers new areas of exploration in performance, and in composition.

Sadly we must mark the death of Herr Stockhausen during the later stages of the completion of this article. He died on 5 December 2007 at his home in Kuerten-Kettenberg. We share the sentiments of his family, expressed in the press release from the Stockhausen-Verlag, that 'he ascended with JOY through HEAVEN'S DOOR, in order to continue to compose in PARADISE with COSMIC PULSES in eternal HARMONY, as he had always hoped to do.'

[14] News has already reached the author of an interested party in London who has made suggestions that an instrument might be constructed from a large bed frame and wood plates of no more than common lumber from a building supply house!