The evolution of the handpan as a musical instrument

In succession of the recently published *Open letter to the Steel tuning community* I would like to dive deeper into the reasons for the importance of the outer shape of the handpan instruments and how it relates to the shape of the Hang and the question of whether this outer shape can be seen as a copyrighted aesthetic choice that is not driven by functional deliberations.

The need for this additional publication has become clear after in depth study of the legal documents from the Landgericht Hamburg that were published by Panart on their homepage and presented in the context of an article that claims that all handpans are infringing the copyright of the Hang and further claims in a recent article about the history of Panart stating that the verdict was spoken against makers of the instrument (instead of resellers).

I will demonstrate how historical and technical facts about the instruments and its making were presented in a distorted way to arrive at the claim that the lenticular shape, the circular note placement and the central dome are not essential to the functionality of the instrument and could thus be seen as random, aesthetic decisions.

Historical perspective on the Hang and Handpan

The obvious starting point when discussing the lenticular shape has to be the moment when it was put together from two steel shells for the first time. How did that happen? The answer is found in different places, the most recent is the aforementioned publication about the history of Panart:

> *„Reto Weber, Musiker des Swiss Percussion Orchestras, bringt am 13. Oktober ein Steelpan zum Stimmen in die PANArt Werkstätten. Als er das neu gestimmte Steelpan einige Wochen später wieder abholt, bringt er auf Wunsch von Rohner sein Ghatam (indisches Gefässidiophon aus Ton) mit und führt das Instrument vor. Dabei äußert er den Wunsch, man möge ein solches Instrument aus Blech bauen und einige Töne einstimmen. Das Problem der Zerbrechlichkeit würde damit gelöst sein. Daraufhin holt Sabina Schärer eine von ihr eingestimmte Ping-Halbschale (ohne Mantel) hervor, Felix Rohner steuert eine ungestimmte Pingschale ohne Mantel bei, beide Schalen werden zusammengeschraubt: Das Urhang liegt vor ihnen. Diese kugelförmige Skulptur mit 60 cm Durchmesser ist der Keim, der zur Linse, zur Hang Skulptur und zum heutigen Balu führen wird.“*
>
> *„Reto Weber, musician of the Swiss Percussion Orchestra, brings a steelpan to the PANArt workshops for tuning on October 13th. When he picks up the newly tuned steelpan a few weeks later, he brings his ghatam (Indian vascular idiophone made of clay) at Rohner's request and demonstrates the instrument. He would very much like to have such an instrument made of sheet metal with a few tuned notes. The problem of fragility would thus be solved.“*
>
> *https://panart.ch/en/history/die-geschichte-der-panart*

The German version of this publication is cited here along with the English version because it clearly states that this moment represents *„the seed of the lenticular shape“*. It is worth also to take a look at one of the earliest mentions of this singular moment of conception of the lenticular shape. On page 13 of the following publication from 2003: http://www.hangblog.org/panart/10-jahre-panart-auszuege.pdf , there is a little note, similar to the recently published one:

„20. November

Reto Weber, Musiker des Swiss Percussion Orchestras, zeigt den PANArtleuten ein Ghatam. Er äussert den Wunsch nach einem vielseitigem, von Hand gespieltem Instrument aus Blech. Das Urhang mit 600mm Durchmesser ist geboren.“

Translation of the text added by me:

„November 20th

Reto Weber, musician at the Swiss Percussion Orchestra, shows a Ghatam to the members of PANArt. He expresses his wish for a versatile, hand played instrument made of steel. The prototype Hang with a diameter of 600mm is born.“

Of course the content of this note differs only in subtleties from the recently published one and might not have to be of special notice, but there is also a photograph next to it that captures the very moment of the conception of the Hang. Since the photograph can not be included in this publication for copyright reasons, I at least want to mention it and direct the attention towards it, especially to the fact that it is Reto Weber who is holding the prototype of the Hang.

The important and ground breaking research and experiments of Panart from before the Hang that were presented to the court are surely worth highlighting, yet there still is this singular moment of conception that went unaddressed. Putting the two shells together in this way for the first time was the answer to a question. To an idea that was presented to Felix Rohner and Sabina Schärer by Reto Weber. The spark that lead to the discovery of the lens shape was a musician who was looking for new ways of expression, for a new way to make music with his hands. The functionality as musical instrument was the underlying question from the very first moment of putting two shells together. When further developing and refining the shape of the Hang from the Urhang, functional considerations were, of course, always a guiding principle:

„The prototype had to be reduced in diameter from 60 cm to 50cm to make it possible to be played on the lap. The challenge was to bring the Helmholtz resonator, the central gong-like sound, and the tone circle, into a unified musical conception.“

http://www.hangblog.org/panart/Paper-Hang-2007.pdf p. 2

Through the years, as the tuners at Panart continued to explore the depths of the Hang their perspective on it shifted. Over time they started to abandon the idea of it being a musical instrument and sought to extrapolate and underline other aspects of the new vessel.

„Musicians who are looking for a musical instrument will be disappointed. The Free Integral Hang eludes the conventional definition of a musical instrument. Its rich dynamic cannot be mastered; there is no technique to be learned. The hang has the strong capacity to intuitively mirror the player.

The marriage of rhythm and melody as perceived by the percussionist falls short. For this, the scope of tones in the hang is too limited. Playing on more than one hang doesn't lead anywhere either: the steel pan family is already chromatic. The Free Integral Hang points in the opposite direction: a sound body of enormous richness which caresses the soul in various manners.“

http://www.hangblog.org/newsletter-panart-may-19th-2010/

When they abandoned the idea of the Hang as a musical instrument they also abandoned the community of musicians and enthusiasts who continued to use the Hang and Handpan as musical instruments. Many of the old Hang that are still in existence and in use today only can continue to sing because of the effort of us panmakers who are following the footsteps of Panart's earlier work of the Hang as musical instrument and are maintaining and retuning these old Hang. The fact that Panart during their own journey stopped considering the Hang to be a musical instrument does not change that it was born as such and that it inspired a new family of instruments.

Reto Weber's idea of a versatile, hand played instrument made of steel with multiple tuned notes hit fertile ground in the music community. The demand for the new instrument could not nearly be satisfied by Panart. Even when they focused all their capacities on it, making about 8000 of them before completely ceasing official production of the Hang in 2012.

The need to have other tuners supply the musical community with new instruments and maintenance service of the existing instruments, became overwhelming at this point of zero supply of new instruments and maintenance service and an ever growing demand.

Panart had abandoned the same musical community that provided the idea for the instrument and that had asked them to create it. When attempting to redefine the Hang as something other than a musical instrument it created a division between the community that had formed around the instrument and its makers. This division and the feeling of being abandoned, being orphaned, was a defining moment for the global Hang player community and can be seen as the seed of today's global Handpan community.

Panart's attempt to stigmatize all handpan makers as plagiarists is a serious misrepresentation of history and the artfulness and creativity of handpan tuners world wide. The skills for making a high quality handpan can only be developed through hard work and innumerable hours of practice and billions of hammer strokes (see Felix Rohner's statement on tuning in the Arte documentary "a discrete Revolution") that bestow the tuner with the experience that is necessary to create a well balanced, great sounding instrument. There was a time in the past when the tuners of Panart themselves spoke of the deep drawn bowl shaped steel shell as the ideal canvas for the artist to paint his/her vision on, the artistic expression was seen in the way the instrument is tuned and balanced and in the notes of the scale chosen, placed and harmonized by the tuner.

> *„Die Vorspannung bestimmt den Wirkungsgrad der eingespannten Schale und damit auch die Art und Weise, wie die Energie durch die Speicher geführt wird und ausschwingt. Für die Schönheit des Impulses ist dieses Ausschwingen entscheidend, in seiner Gestaltung liegt die Kunst des Stimmens und damit die Wirkung des Instruments." Hang p.17*
>
> Translation of the text added by me:
>
> *„The stresses that are introduced with the hammer by the tuner determine the efficiency of the clamped shell and with it the way in which vibrational energy is transferred within the network of vibrational modes and how it settles towards the end. The beauty of the impulse is defined by how the vibrational energy settles, in its arrangement lies the art of tuning and thus the effect of the instrument."*

„The remaining four notes are tuned in with artistic freedom by the tuners.“
http://www.hangblog.org/panart/Paper-Hang-2007.pdf p. 7

The different perspectives on the history of the instrument are well established in the community and have coexisted for many years and would not have to be dragged into the spotlight, if they were not used in conjunction with technical misconceptions to mislead those who are unfamiliar with the historical and technical details, in a way that endangers the future and the evolution of this new instrument.

Technical and functional importance of the shape of the instrument

How to start explaining what should be obvious? The handpan is an instrument for which the resonance body is also the source of sound production (= idiophone) that is played with the hands on all parts of its physical surface, that is so delicate and intricate that every little indentation, every little hammer mark contributes to the overall sound and experience, that easily allows the player to completely stop rationalizing his playing and become one with the music, how could you ever separate its functionality from its form?

Of course this is a rhetorical question and the answer is simply that you can not separate the two, every handpan player who ever entered the ecstatic free flow, that the handpan allows so much more readily and freely than any other instrument, will know this to be true.

But since this in its entirety is impossible to measure and quantify we will start with physical and technical properties of the shape and work our way up to the magic that is the final result of all contributing factors.

In the verdict of the Landesgericht Hamburg it can be seen that Panart presented a variety of instruments to prove that similar sounds can be achieved with differently shaped instruments. Of course the question needs to be raised here: How is defined what is similar? The answer to this question is found in the court document:

> *„Dabei hat die Kammer bereits im Rahmen der mündlichen Verhandlung deutlich gemacht, dass bei der Benutzung des Wortes „Klang“ zu differenzieren ist: Gemeint sein kann im Rahmen des vorliegenden einstweiligen Verfügungsverfahren nicht eine akustisch exakte Vermessung des gesamten Klangspektrums der betroffenen Instrumente; denn der Kammer war weder eine solche Messung möglich, noch verfügen die Kammermitglieder über ausreichende Erfahrung, um Feinheiten unterschiedlicher Klangspektren selbst analysieren und beschreiben zu können, soweit sie sich nicht in für*
> *das normal musikalisch vorgebildete Ohr erkennbaren Unterschieden in der Klangfarbe niederschlagen. Wenn die Kammer daher im Nachfolgenden von „Klang“ spricht, so ist damit das Gesamtklangbild als gesamtheitlicher Höreindruck gemeint, welches ein durchschnittlich musikalisch vorgebildeter Zuhörer bei einer Vorführung des Instruments wahrzunehmen in der Lage ist.(Nicht gemeint sind mit unterschiedlichen Klängen dagegen unterschiedliche Tonhöhen im Sinne der Frequenzen der Grundtöne der Klänge).“*
>
> *https://panart.ch/files/documents/Urteil-Hamburg/Urteil-Landesgericht-Hamburg-Urheberrecht-fuer-Hang-Skulptur-geschwaerzt2.pdf S.42-43*

Translation of the text added by me:

„For this purpose the court has already specified during the hearing that when the word „sound“ is used, it is used in the following sense: Within the frame of a court hearing to decide on the issuing of a temporary restraining order it is not possible to consider precise acoustical measurements of the entire sound spectrum of the instruments because neither were such measurements possible, nor do the members of the court posses the necessary experience to evaluate and analyze the subtleties of different sound spectrums, in so far as they are not perceivable in the timbre of the instruments for the averagely trained musical hearing. When the court uses the word „sound“ it then signifies the overall perception of the timbre and sound that an averagely musically trained listener is able to hear when the instruments are demonstrated. (It does not signify differences in the pitch of the sound).“

How much weight should relative perceived auditory similarity to an untrained ear carry for the overall experience of the musician and the work of the tuner? Especially since differences were noted despite the less than ideal circumstances:

„(...) sein (sic!) eigener Handpan hatte eine (sic!) etwas andere (nach dem subjektiven Eindruck der Kammer etwas wärmeren) Ton.“ S. 43

Translation of the text added by me:

„his (David Kuckhermann's) own handpan had (in the subjective perception of the court) a slightly warmer tone.“ p.43

But the court nevertheless concluded after the comparison of different Hang, Handpans and instruments of other shape:

„(...) doch auch hier waren die Klangbilder angesichts der gänzlich unterschiedlichen Formen der Instrumente erstaunlich ähnlich.“ S. 43

Translation of the text added by me:

„ (...) in the end the overall sound created was, despite the very different shapes of the instruments, surprisingly similar.“ p. 43

This is a very crucial point and something that I feel warrants further consideration.

The instruments as well as theoretically proposed shapes, completely different in comparison to Hang and handpan, that were presented by Panart to prove their point can be seen in low resolution pictures in the document and because verdicts issued by German courts are not under copyright protection can be shown here:

The so called Tubal was used to show that singular, isolated notes connected to a a Helmholtz resonator can create surprisingly similar sounds to a Hang. If considered on a superficial level, this can be true: a nonlinear reacting, three dimensional shell structure, tuned with fundamental, octave and twelfth, is substantiated by the air frequency of the resonance body. So some of the main contributing factors to the sound production are indeed there, and in that way the sound can be described as similar, but many other factors contributing to the sound and overall experience of the Hang and Handpan were not considered, a very important factor was described by Panart in their 2013 publication „Hang“ :

> *„Treffen Teile der Hand auf der Schale auf, vernimmt man den Gesamtklang des Resonators: Ein Clusterklang, der alles beinhaltet, was schwingen kann. Dieser Grundsound ist beim Hangspiel immer da. Sein Reichtum bildet den sphärischen Schatz des Instrumentes. Ein gut geschultes Gehör kann eine Analyse machen und die verschiedenen Frequenzen heraushören.“ S.16*
>
> Translation added by me:
>
> *„When parts of the hand make contact with the shell, the overall sound of the resonator can be heard: a sound cluster that contains everything that can vibrate. This background sound is always there when playing a Hang. Its richness is the spherical treasure of the instrument. A well trained ear can analyze this sound cluster and identify the individual frequencies.“ p. 16*

This underlines „(…) the nature of the Hang as a wholistic resonant body.“ (http://www.hangblog.org/letter-from-the-hangbauhaus-november-2009/) and shows how an oversimplification like the statement that Tubal and Hang sounds are similar, or even as claimed by Panart to the court: identical (p. 20), can not be used to diminish the importance of the shape for the overall sound and experience. Other important factors are: the network or Plexus picture with transverse vibrational energy moving via the internote and its direct influence on domain interaction and note layout.

Of course considerations of playability and ergonomics make it obvious that the Tubal could never be played in the same flow as the Hang and Handpan, this free flow is essential to players of the Hang and handpan and is in great parts derived from its form and note layout:

> *„An instrument to get into the mood of a free flow. A tuning instrument. Harmonization through absorbing that which flows from the hands.“*
>
> *http://www.hangblog.org/the-call-of-iron/*

> *„We have, however, condensed those spheres to which hearing humans react with a particular well-being to a chorus – a resonance body into which one becomes immersed. This happens through a range of sounds and a form – one that integrates. Its wealth is revealed through free and intuitive playing with the hands.“*
>
> *http://www.hangblog.org/the-integral-hang-2009/kkk*

Along the same line of reasoning, that isolated notes can create similar sounds to the Hang, Panart proposed to the court a change to the shape of the instrument by attaching the individual notes via bridges to the resonance body:

> *„Aber auch eine wie nachfolgend abgebildete Ausformung von Tonfeldern mit stegartiger Befestigung im Resonanzkörper wäre für alternative Gestaltungen des „Hang" denkbar:“*
>
> Translation added by me:
>
> *„But also an implementation of notes with a bridge-like attachment to the resonance body would be an option for alternative shapes of the Hang:“*

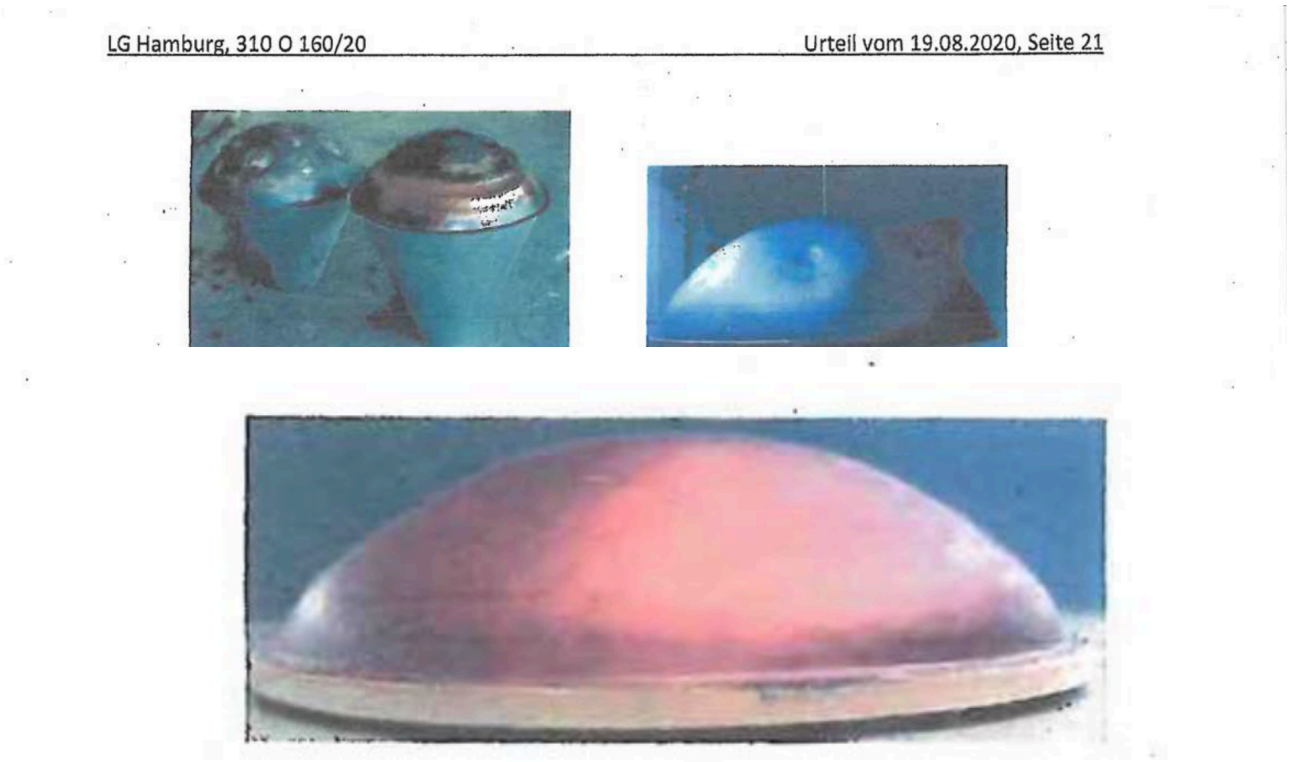
This would greatly diminish the instrument’s function as a complex harmonized spherical structure, where all energy transfer between the modes via the internote can be balanced by the tuner to have them interact in a pleasant way, which greatly contributes to the sound and functionality of the instrument.

Dr. Achong describes the inherent disadvantages of such constructions in *Secrets of the Steelpan.* While he refers to the bolted attachment of a skirt to the steel pan, the argument holds true for such a construction of attaching individual notes via a bridge to the resonance body: „(…) *these joints become absorbers of vibrational energy* which reduces the efficiency of the instrument. This wasting of energy occurs whether or not the vibrations are discordant.“ Even „When the bolts are tightened and the combined system made mechanically sound (…)“ and thus „ (…) the two fastened members cannot be said to be isolated from each other.“ The bridges and bolts would still introduce

additional vibrational modes to the instrument's body and „If it is intended to use rubber isolators on the bolts then this increases the degree of freedom of the bolted structure, introduces additional vibrational modes and motions and greatly complicates the dynamics." Achong p.1087

If glue were used instead of bolts as a way to connect bridge and resonance body, the argument of energy loss and additional vibrational modes would still stand.

A number of propositions of possible changes to the general shape of the instrument show other ways than a symmetrical synclastic shell to clamp the pan face layed out on the top shell. While keeping the top shell in the general shape of a section of a sphere:



These pictured proposed shapes stand by far the strongest of all in Panart's argumentation. The functionality of the pan face on the top shell is not severely compromised by these ways of clamping the top shell, as long as they still allow the whole resonance body to act similar to a Helmholtz resonator.

Of course the inherently existing vibrational modes of such constructs would need to be taken into account and it is furthermore untrue that the only purpose of the opening is to create a Helmholtz resonator, as was claimed by Panart to the court:

> *„Die zentrale Öffnung des „Hang" am unteren Kugelsegment funktioniere vergleichbar mit einem Helmholtz-Resonator und verleihe den erzeugten Tönen eine gewisse Tiefe. Ob diese Öffnung jedoch in eine Rundschale, ein Oval, oder eine Pyramidenform eingearbeitet sei oder durch eine flaschenartige Verjüngung erzeugt werde, sei für das konkrete Klangverhalten ebenso wenig entscheidend wie die Positionierung dieser Öffnung." S.22*
>
> Translation added by me:

„The central opening of the Hang on the lower spherical section would function similar to a Helmholtz resonator and add depth to the sound of the notes. Whether this opening is placed in a shell shape, an oval structure or a pyramid shaped, as well as its positioning on such a structure, should be irrelevant to the actual sound production.“ p. 22

The vibrational modes created by the opening are tuned to specific frequencies on Hang and handpan instruments and are used by players by striking the edge of the opening. Changing the shape of the structure on which it is placed or changing the shape of the opening itself of course will affect how well these vibrational modes can be tuned and how they interact with each other and the rest of the instrument.

However while on a whole this argument stands on comparatively more solid ground for the Hang, it does completely ignore the evolution of the handpan as a musical instrument. For many years now handpan makers all over the world have been using the synclastic bottomshell as a second pan face to expand the musical range and potential of the instrument. As soon as the lower half of the instrument serves as a pan face, all the technical considerations and experience that have shown the bowl shape to be the ideal shape on which to tune a network of notes apply to this lower half as well. For a more in depth discussion of the functional advantage of the bowl shape please refer to the earlier mentioned publication *Open letter to the steel tuning community*.

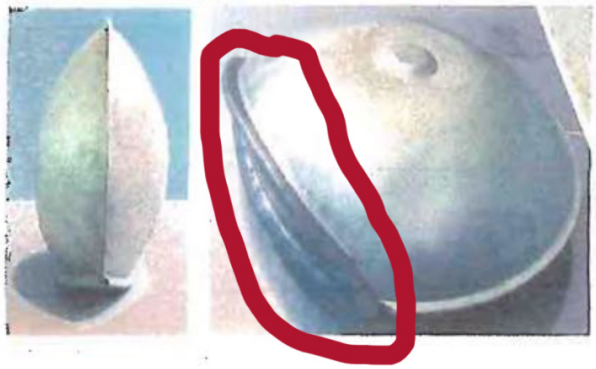
One more proposed shape for alternatively formed sound sculptures needs to be put in the same context of discussion of the characteristics and advantages of the bowl shape:

This cone like shape, is actually just an elongated bowl structure. Elongating the bowl shape in this way results in a drastically changed curvature, the curvature is an important parameter that is adjusted to serve the needs of the tuner and the instrument, as is discussed in the above mentioned letter. Randomly changing it without purpose does compromise the work of the tuner and the resulting instrument and ignores the fact that curvature is a technical parameter that is purposefully used by the pan maker to serve his needs.

The alternative shape presented by Panart to the court that seemingly was considered the most convincing is this one:

While it can be seen that is was very cleverly constructed to support Panart's claims, every tuner will immediately recognize the shortcomings of such shape. It was clearly created by deformation of the same shells that are used to form the Hang. By this deformation discontinuities are introduced into the shell structure and new, additional, vibrational modes are introduced and will contribute to the overall sound of the instrument. Furthermore „Internal discontinuities can also produce reflections that convert transverse vibrations into longitudinal vibrations resulting in mode conversion that robs the primary (transverse) mode of energy." Achong p. 379, So for any of the proposed shapes it needs to be clear that „Mode conversion always robs transverse vibrations of its energy at edges, folds and sharp corners." Achong p. 840, this is highly problematic because „On the pan, the longitudinal vibrations are poorly radiated acoustically (…)" Achong p. 841

Besides the problematic loss of energy through the discontinuities, the newly introduced vibrational modes do indeed also explain the amount of, what I assume is, rubber that was consecutively put onto the deformed rim:



This was clearly done to dampen these vibrational modes because they interfere with the sound and compromise the quality (it additionally might bring some ergonomic advantage to this particular „sculpture", but nevertheless it is covering up the inherent problems caused by the deformation) Trying to tune notes close to such a deformed rim will not yield notes of comparable sound quality to notes placed next to a regular rim and diminishes greatly the overall surface of the pan face.

The notes on this instrument seem to have all been placed on the far side of the deformed rim for a reason. This will only be obvious to the trained eye because the notes on this instrument were shaped and tuned without dimples, maybe to make the instrument appear less like a deformed Hang and more unique, maybe to underline the contention that note shape is not important to sound quality but is claimed to be an aesthetic choice.

While different note shapes to a certain degree are possible, there are clearly identified physical principles that determine what is feasible. These principles and their influence on our work as tuners have already been outlined in the *Open letter to the steel tuning community*. To further substantiate our arguments presented there, I would like to point out the advantages of dimpled notes here:

> *„Um die Töne zu formen mussten wir wir das Blech mit einem Keil stauchen. Dadurch entstand ein Nabel. Am Anfang versuchten wir noch, diesen Nabel wieder zu einer Platte abzuflachen, bis wir erkannten, dass er uns etwas neues brachte, das von Vorteil war. Der Klang war stabiler, der Grundton stärker.“*
>
> Translation added by me:
>
> *„To shape the Notes we had to compress the metal with a shim. This created a dimple (navel). In the beginning we tried to flatten the dimple back into a plate shape, but then we realized it brought something new to the equation that was actually an advantage. The sound was more stable, the fundamental stronger.“*
>
> *http://www.hangblog.org/panart/10-jahre-panart-auszuege.pdf p. 24*

Further reference to these advantages can be found in the publication „Hang“, up to and including a precise description of how note shape correlates to sound quality and playability (compare „Rohner-Schärerscher Beulfall“ in „Hang“ 2013 p. 26)

In this context it is important to point out the technical aspects of the difference between a note with an inward facing dimple, and a note with an outward facing dimple like the Ding on the Hang. Handpan makers all over the world have experimented with this parameter for years. Notes with inward and outward facing dimples have been placed on every possible position of the pan face including instruments featuring only notes with outward facing dimples.

Through these experiments it has become clear that there are subtle but important differences between the two possible directions of the dimples. The way that the energy of the excitation from contact with the player’s hands is transferred to the vibrational modes of the note is noticeably different, this is probably due to the fact that usually players strike a note with outward facing dimple in the middle of the dimple while notes with inward facing dimples are usually struck directly on the note.

When going more into detail, empirical evidence seems to indicate that notes with outward facing dimples, when hit straight on the dimple, have a wider angle of sound projection than notes with inward facing dimples. This has practical implications for decisions that tuners face when designing their instruments, for example some tuners prefer to use inward facing dimples when placing two low notes with a semitone interval (while on either of the two notes singularly outward facing dimples would be chosen) on the same instrument to lessen the influence of the so called crosstalk phenomenon on the overall sound of the instrument. For further discussion of this crosstalk phenomenon please refer to the *Open letter to the steel tuning community*.

It is evident that every little change to the form and design of the instrument has functional implications for the resulting musical instrument and, as shown, every single one of the proposed alternative shapes would compromise the potential sound quality in comparison with the traditional shape. Of course it could be argued that these proposed changes were just examples for possible changes to the shape and that other shapes could be found that will not have a negative impact on sound quality or playability of the instrument. To counter such an argument and show that there is

no necessity to point out the disadvantage of every single imaginable shape, I feel it is necessary to put it into context of general deliberations concerning the lenticular shape and to point out the inherent advantages of this particular shape.

This is best done by using a simple analogy, one that is deeply embedded in our cultural context. It is the question whether the wheel could be reinvented in a different shape?

Of course the Hang and handpan with their lenticular shape are infinitely more complex than a wheel, considering their three dimensional spherical geometry, the purpose of the handpan to be used as a musical instrument and the many parameters that even make it at all possible for the tuner to precisely tune frequencies into it. But in sight of this complexity it seems the simple truth that its shape is the best and most obvious choice to do the job, was lost in the eyes of those not familiar with the instrument. This is where creating an analogy to the wheel can help to understand.

Why is the wheel the best possible shape to serve its function? The two most relevant facts about the wheel are: 1. there is a pivotal point in the middle of the shape 2. On the outside of the wheel is the rolling surface, this rolling surface only then works properly when it is in equal distance to the pivotal point on all of its parts.

The wheel analogy is very helpful to understand why other shapes will technically never work as well as the lenticular shape. Wherever a discontinuity is introduced to the round shape of the wheel it will immediately affect its functionality. The same is true for the lenticular shape. Every discontinuity in the spherical structure will automatically create unwanted additional vibrational modes and will result in vibrational energy loss through mode conversion and thus will negatively impact the potential for the highest possible sound quality that can be achieved with this shape.

One very important aspect of the functionality of the handpan is the way that transverse vibrational energy travels via the internote. In the same way as the wheel needs to be round to roll, the handpan needs to be spherical to allow for the least interference with how transverse vibrational energy is traveling in the instrument.

From a player's perspective in the middle of the Hang and handpan there is also a pivotal point: the Ding, the central bass note, this note usually is the dominant or tonic of the scale that the instrument is tuned to. Through its central position on the lenticular shape this pivotal point is in equal distance to the other notes and to the player. This also is of essential importance for the flow in which the instrument is played.

We handpan makers welcome this discussion about the functional importance of the lenticular shape just like Panart welcomed handpans that were inspired by the hang more than ten years ago:

> *„After nine years news has reached us about instruments similar to the hang from other countries. We are not unhappy about this because discussions are now being launched regarding the quality aspects of those resonance bodies which only work if they are created with dedication."*
>
> *http://www.hangblog.org/the-integral-hang-2009/-*

Many handpan makers are creating their instruments with the utmost dedication to the highest possible sound quality and in the collective of hundreds of handpan makers world wide remarkable advancements to the sound quality and musical potential of the instrument have been achieved. Many examples for this can be provided: be it the actual instruments, video material of the

wonderful music created with them or professional musicians who started as hang players a long time ago and today prefer to play handpans by other makers because of the increased potential for musical expression that these newer instruments offer.

We handpan makers will not accept to change our instruments to shapes that have inferior musical potential. The uniqueness of the lenticular shape lies in its simplicity: the least possible amount of vibrational modes exist outside of those hammered into it by the tuner, it provides the ideal canvas for the tuner to show his art. Whenever a change of shape introduces discontinuities and additional vibrational modes it will have to be regarded as providing inferior musical potential, a less ideal canvas for the art of tuning.

While these points might not be of the greatest importance to the Hang, if it is supposed to be considered an art object, a sculpture that also produces musical sounds, they however are essential to the work of the handpan makers who create musical instruments and dedicate their life's work to strive for the highest musical quality. The following statement by the late Dr. Achong sums it up in regards to the steel pan and can be equally applied to its sibling: the handpan.

> *„The Steelpan is a musical instrument so any truly significant improvement on the Pan must express itself in the sound it produces — after all, that is what we get from it."*
>
> *Achong p.1097*

The musicians who are using these instruments rely on us tuners to advance this art form, the evolution of music created on tuned steel has always progressed through the symbiotic relationship between tuners and musicians:

> *„The input provided by calypso in particular, makes it difficult to determine whether pan music directed the pan makers or pan makers directed the musicians. The late Calypsonian, Aldwyn Roberts, better known as 'Lord Kitchener', arguably the greatest of all composers of pan music, would have admitted (the author believes), that it was the latter.* ***The form, both physical and musical, given to the pan over the decades, remains the standard by which present-day pans are made."***
>
> *Achong p. 860, Emphasis on the last sentence added by me*

The conception of the Hang is a prime example of the wondrous incitement to the musical evolution that is a symbiotic relationship of musician and instrument maker.

References:

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