The KNIGHT REVISION of HORNBOSTEL-SACHS: a new look at musical instrument classification

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Introduction

The year 2015 marks the beginning of the second century for Hornbostel-Sachs, the venerable classification system for musical instruments, created by Erich M. von Hornbostel and Curt Sachs as *Systematik der Musikinstrumente* in 1914. In addition to pursuing their own interest in the subject, the authors were answering a need for museum scientists and musicologists to accurately identify musical instruments that were being brought to museums from around the globe. As a guiding principle for their classification, they focused on the mechanism by which an instrument sets the air in motion. The idea was not new. The Indian sage Bharata, working nearly 2000 years earlier, in compiling the knowledge of his era on dance, drama and music in the treatise *Natyashastra*, (ca. 200 C.E.) grouped musical instruments into four great classes, or *vadya*, based on this very idea: *sushira,* instruments you blow into; *tata*, instruments with strings to set the air in motion; *avanaddha*, instruments with membranes (i.e. drums), and *ghana*, instruments, usually of metal, that you strike. (This itemization and Bharata's further discussion of the instruments is in Chapter 28 of the *Natyashastra*, first translated into English in 1961 by Manomohan Ghosh (Calcutta: The Asiatic Society, v.2).

The immediate predecessor of the *Systematik* was a catalog for a newly-acquired collection at the Royal Conservatory of Music in Brussels. The collection included a large number of instruments from India, and the curator, Victor-Charles Mahillon, familiar with the Indian four-part system, decided to apply it in preparing his catalog, published in 1880 (this is best documented by Nazir Jairazbhoy in *Selected Reports in Ethnomusicology* – see 1990 in the timeline below). Mahillon translated the four Indian terms, in the order above, as: aerophone, chordophone, membranophone, and autophone.

In creating the *Systematik*, Hornbostel and Sachs intended to take the concept of Mahillon's catalog and broaden it to be globally applicable. They developed a hierarchy of terms that could be used to consistently identify any musical instrument, or more broadly defined, any sound-producing mechanism, that mankind might have invented. Their first step was to replace Mahillon's fourth term, autophone, which they felt could be interpreted as an instrument that would sound without human intervention. To replace it they coined the term idiophone, with the root *idio-* identifying instruments in which the primary vibrating entity is the body of the instrument itself. The *Systematik* had the subtitle *ein Versuch*, or "an exploration," clearly implying that the authors intended to start a discussion among organologists, but the need among museum scientists for the classification was so great that it was simply adopted and has today become the standard system, known by all musicologists with an interest in musical instruments.

In 1961 the *Systematik* was translated into English by Anthony Baines and Klaus P. Wachsmann (the latter a student of Hornbostel and Sachs) and published in the *Galpin Society Journal* as "Classification of Musical Instruments." By this time the term "ethnomusicology" had been coined by Jaap Kunst. He published his book of this title in 1955, and by the time of the more familiar second edition of 1959, organology was fast becoming an important sub-specialty in ethnomusicology. The present author, having already begun collecting instruments as a teen at this very time, was swept up in this. As an entering graduate student in 1966, I found myself sitting opposite none other than Klaus Wachsmann, now a professor at the UCLA Institute of Ethnomusicology. He taught the organology seminar, and Mantle Hood, director of the institute, would soon present (in *The Ethnomusicologist,* 1971) his organograms, a method for encapsulating the classification, playing technique, relation of player to instrument, and other salient details about instruments into a single diagram per instrument.

Today even elementary school children might learn the four great classes of the Hornbostel-Sachs system, and most might readily know a fifth type, electrophone. For this term we are indebted to Francis W. Galpin, who devoted a chapter in his *Textbook of European Musical Instruments* (Dutton, 1937) to the timely subject of "Electrophonic Instruments."

The Hornbostel-Sachs system (hereafter H-S) situates an instrument in the scheme with a string of numbers separated every three digits by a decimal point in the style of the Dewey Decimal System, in common use by libraries for cataloging books until the 1970s. In the *Systematik* the first number tells the broad class, or family, in this sequence: 1, idiophones; 2, membranophones; 3, chordophones; and 4, aerophones. Each number after the first represents the next step in the hierarchy. Some instruments require as few as two. For example, the number 22 is sufficient to designate what Hornbostel and Sachs called a "plucked drum" (a now obsolete term). On the other hand, if an instrument shares features with many others, distinguishing it may require as many as nine or more digits. A clapper bell, such as used in carillons, for example, is 111.242.122 in the H-S system. Although objections have been raised that the strings of numbers are unwieldy, they provide a clear path to accuracy and specificity.

In devising the Knight-Revision, which may be abbreviated K-Rev, the method of assigning a number to an instrument is retained. Likewise are the four (now five) broad classes. The manner of assigning subdivisions also resembles that of H-S, but here the comparison breaks down. Those who are familiar with H-S, and especially those who might have memorized some of their favorite numbers, must put away all memory of them in studying K-Rev, because the first principle in the creation of K-Rev was to abandon the H-S subdivisions in order to allow rethinking the system at every level.

In order to assure that K-Rev numbers cannot be confused with H-S numbers, in K-Rev the first digit is a letter, followed by the numbers. The letters are drawn from the names of the five classes in English. I feel these are well-enough known in their second century of use to negate any complaint of a linguistic bias. In addition to assuring that K-Rev numbers will never be mistaken for H-S, I believe it is easier to remember numbers when they start with a letter. Thus, the five broad classes in K-Rev are identified as follows:

Y for Idiophone – a solid or hollow body produces the sound (Y is used in place of I to avoid being mistaken for the Roman numeral I, or in some fonts, a lower-case L).

M for Membranophone – a stretched membrane or diaphragm produces the sound.

C for Chordophone – a stretched "string" (understood to mean various materials, such as silk, hide, gut, vegetal fiber, metal wire, nylon) produces the sound.

A for Aerophone – air is made to vibrate by blowing (by mouth or mechanically) into an enclosure, variously defined, or by moving an object through the air.

E for Electrophone – electric or electronic circuits produce the sound.

A Brief Timeline of Innovations in Organology

For the term organology, defined as the scientific study of musical instruments, we are indebted to the composer Michael Praetorius, who wrote a treatise in 1618 entitled the *Syntagma Musicum*, a compendium of European musical knowledge of his time. A year later he published a second volume entitled *De Organographia*, focused on musical instruments (see in English translation by David Z. Crookes, Oxford: Clarendon Press, 1986). He coined the title of this volume from the ancient Greek term *organon,* an implement or tool, in this case, the tools of music-making. For his efforts, Praetorius is usually dubbed the father of organology. We might also dub him a budding ethno-musicologist, for although the book is focused on European instruments, he included several engravings of instruments from various parts of the world.

To look at innovations, of course we must look first at inventions. The Chinese were the first to invent a classification system. It was called *pa yin (bayin)*, or eight sounds, and it dates to ca. 2200 BCE. Various dates are given for this system, but according to Kartomi (1990:37) it is associated with the legendary emperor Shun (2233 to 2188 BCE. The eight sounds were not so much sounds as they were materials. The materials (in alpha-betical order) were bamboo, bronze, clay, gourd, silk, skin, stone, and wood. We might conjure up a sound in our mind from each of these materials, but this is not how the system worked. The materials clay and gourd, for example, were not included because they made sounds (as they can do as idiophones), but because clay was the material for a vessel flute, and gourd was an enclosure for the world's first free reeds. Rather, the eight sounds were part of a cosmological picture. They were associated with the cardinal directions, seasons, and other features, and the ceremonial court music of the day was played by an ensemble that included all of them, to represent the perfect universe. The *pa yin* system is not something that has been applied in modern times, but its mere existence is a reminder that studying musical instruments is an excellent window on a culture. An excellent contemporary look at this concept is an article by Kevin Dawe, "The cultural study of musical instruments" in the book "*The cultural study of music: a critical introduction,* ed. by Martin Clayton *et al* (Routledge, 2012, p. 195-205). Dawe's principal point is that organology is not just about classifying instruments, but about understanding what they can teach us about the role of music in people's lives.

Fast forward over two thousand years to the next "invention" we know about, which is the Indian system presented in the *Natyashastra.* Fast forward another millennium and a half to Praetorius, who did not actually propose a classification system, but whose works stand as a model for the scientific study of musical instruments.

To present a bibliography of organology from the time of Praetorius to the present day would take many pages, but keeping the focus on innovations beginning with Mahillon, the list becomes manageable. Three resources that do present the broad overview may be singled out as follows:

1990 Margaret Kartomi, *On concepts and classifications of musical instruments* (University of Chicago Press)

1992 Geneviève Dournon, "Organology" in Helen Myers, ed., *Ethnomusicology, an introduction*, p. 245-300 (New York: Norton)

2014 "Classification" in the *Grove Dictionary of Musical Instruments*, 2nd Ed. (Oxford U. Press), v. 1, p. 568-79. The core of this article is the entry by Klaus Wachsmann for the 1984 edition, expanded by Kartomi and Jeremy Montagu.

1880 Victor-Charles Mahillon publishes his *Catalogue descriptif et analytique du Musée instrumental et Conservatoire royal de musique de Bruxelles* (Ghent: Libraire Générale de Ad. Hoste). A second edition appeared in 1893. His innovation was to adapt the Indian system to this collection.

1900 Francis W. Galpin (duly recognized today by the society in his name) prepares a classification scheme (we may call it Galpin 1) for the musical instruments in the International Loan Exhibition at London's Crystal Palace. He published it as an appendix in his 1910 book, *Old English instruments of music*, and it is included in the 4th edition, Barnes & Noble, 1965.

1914 Erich M. von Hornbostel and Curt Sachs publish "Systematik der Musikinstrumente. Ein Versuch" in *Zeitschrift für Ethnologie* Heft 4 & 5, p. 553-90, and scholars begin to apply it. According to Dournon (1992:252), the first was Georges Montandon, for his 1919 catalog of the Musée Ethnographique in Geneva.

1932 André Schaeffner publishes "D'une nouvelle classification méthodique des instruments de musique" in *La Revue Musicale* (13/129, p. 215-31). Schaeffner's system starts with only two main classes based on the nature of the vibrating material: (1) the air itself, or (2) a solid material, subdivided into rigid (idiophones) or flexible (lit. susceptible to tension) meaning strings and membranophones. Wachsmann, in the UCLA seminar, praised the "logically perfect and coherent" nature of Schaeffner's system (and described it thus in the "Classification" article noted above (GDMI, 2014, v.1, p. 570). The problem is that Schaeffner did not fill in the details of his system, leaving this to others. This and the lack of an English translation mean that Schaeffner's system remains today as only a philosophical entry in the organological endeavor. At the same time, it is clear that he recognized the importance of H-S, providing a little-known translation of the basic concepts into French in his "Adaptation française de la classification des professeurs E. M. von Hornbostel et C. Sachs" in *Encyclopédie Française*, 16 (1935), p.15-16. Also, in 1936 he published his most important work, *Origine des instruments de musique*, which was to be an important resource for future researchers such as Dournon (see 1992 below).

1937 Galpin presents his second system in *A Textbook of European Musical Instruments* (New York: Dutton, p. 25-36). Already in the 1932 edition of his earlier book, *Old English instruments of music*, he had added a passage about H-S, describing it as "[an] intricate system [that] has not been generally accepted" (1932:314). His solution, which we may call Galpin 2, was to begin with the four families as named by Mahillon, add (for the first time) "electrophonic instruments," and then apply a set of uniform subdivisions to a certain depth.

Galpin's efforts deserve more attention than they have received. He was taking on H-S, although he did not state it directly. Building on Mahillon's approach, his first subdivision in each major family was "Principle of sound production." For the idiophones ("autophones"), membranophones, and chordophones, this meant playing technique, largely neglected for chordophones in H-S. He also presented a code that supplanted the Dewey-style strings of numbers in H-S, which he found daunting, with a sequence of upper/lower case Roman numerals, upper/lower case letters, then numbers, always in this order. An example is III,i,A,a,1, the designation for a plucked musical bow. Itself daunting at first glance, this system can be learned fairly easily with a minimum of study. It was admittedly not intended to show the same detail as H-S (1937:29).

The principal downfall in Galpin 2 is that by making playing technique the prime choice in chordophones (divided by (i) plucking, (ii) striking, (iii) friction, or (iv) air), Galpin confused the picture. Instruments as diverse as the harp, lyre, and psaltery all receive the same number as the musical bow above (open strings without a neck, plucked directly), while the generic lutes (guitar or violin, for example) end up widely separated by their playing technique rather than grouped together by their basic construction (a body with a neck).

For aerophones, Galpin's system works much better and even corrects two problems in the handling of reeds in H-S. In Galpin's aerophones (III), the first subdivision, "Principle of sound production," translates to (i) flue-voiced (flutes), (ii) reed-voiced, and (iii) lip-voiced, thus matching H-S. But significantly, under reeds, bore shape is the first choice: (a) cylindrical or (b) conical, with the number of reeds next in the hierarchy. Without mentioning H-S, Galpin spells out why his sequence is correct: it is bore shape rather than the number of reeds that gives an instrument its distinctive tone color (1937:31). Galpin's second contribution to clarity in the aerophones is to give a third choice in the reed section: (c) framed, for instruments without a bore, i.e., the free reeds (mouth organ, accordion). Galpin does not include the category of free aerophone, calling the familiar bullroarer or *rhombe* an air-vibrated chordophone (p.157). All of these points will be discussed in more detail below, but for reeds in K-Rev, the model is Galpin, not H-S.

1948 Hans-Heinz Dräger publishes his *Prinzip einer Systematik der Musikinstrumente* (Kassel: Bärenreiter). Dräger, a student of Sachs, and for a time director of the State Museum of Musical Instruments in Berlin, published his work to address what he felt were serious inconsistencies and limitations in H-S. He could not accept the logic of including playing technique as a major item in the idiophones (struck, scraped, plucked, for example), while omitting this factor almost entirely in the chordophones, which are subdivided by shape and other physical details instead. To address this, he developed a list of nine facets that should be dealt with separately when classifying an instrument. The first was the appearance, or morphology, of the instrument (much as in H-S). The second was playing technique. The remaining facets included such details as melodic capability, range, tone color, and the relationship of the performer to the instrument. Unfortunately his mind raced far ahead of the technology that would have made his scheme workable (i.e., computers). What he did present was the manner in which the first of these, the morphology of an instrument, could be covered by answering a series of questions about an instrument and displaying the answers in fourteen columns. This he did, in 24 pages of tables for selected instruments in the H-S system.

Dräger's system bears study, but it is a daunting task. Fortunately, two authors, Kvifte and Kartomi (see 1989 and 1990 below) have done so and provide excellent summaries. (Kartomi also notes that Michael Ramey, in "A classification of musical instruments for comparative study" (PhD, UCLA, 1974) has demonstrated how to computerize Dräger's system.)

1961 The English translation of H-S by Anthony Baines and Klaus P. Wachsmann is published in the *Galpin Society Journal* 14 (3-29) as "Classification of Musical Instruments."

1971 Jeremy Montagu and John Burton publish "A proposed new classification for musical instruments" (*Ethnomusicology* 15/1, p. 49-69). The authors observe that the decimal numbering system used by H-S imposes some rigidity on adding newly-discovered items if they possess features that are not already included in the system. They suggested that a more workable system would be a key, as used in Linnaean classifications, that would not rely on numbers for keeping order, but a list of agreed-upon terms that would be used to identify any sound-producing item. Their point is well taken. They invited input from fellow scholars, but the extent to which this was successful is unknown, because there has been no further publication about it.

1971 Mantle Hood, in his book *The Ethnomusicologist* (New York: McGraw-Hill) introduces his idea: the organogram. His intent was not to modify H-S, but to add to it, much as Dräger had proposed, but in such a way that whatever information was known about an instrument, it could be included in a relatively easy-to-draw diagram that served as a kind of shorthand for details not in H-S, such as the physical relationship between instrument and player (i.e., holding or embracing an instrument or sitting in front of it), the playing technique (where not included in H-S), whether the instrument was hand-made or factory built, and other cultural factors. The chapter is essentially a manual for how to do this (1971:123-96).

1982 Tetsuo Sakurai publishes "The classification of musical instruments reconsidered" (Japan: *Bulletin of the National Museum of Ethnology*). Dournon describes it as follows: "[Sakurai] questions the Hornbostel-Sachs categories; Sakurai suggests a classification on three levels, leading to a division of instruments into 'seven main classes with sub-classes in each. The sub-classes are based on the number of the primary vibrators of each instrument.' This approach, claimed to be 'intermediate between scientific accuracy and practical utility' is not easy to apply" (1992:252).

1985 René T. A. Lysloff and Jim Matson publish their article, "A new approach to the classification of sound-producing instruments" (*Ethnomusicology* 29/2, p. 213-36). The crux of the Lysloff/Matson approach is that it is designed to include "the dynamic interaction between instruments and human behavior." They argue that the endeavor of grouping instruments according to shared observable characteristics may be accomplished with the aid of a form of data analysis called Multidimensional Scalogram Analysis. It produces a graph that situates individual instruments and others like them in a format that is readily interpretable by scholar and layperson alike (1985:213). Again, the points they make are well taken: organology is not just about describing and pigeonholing objects, but should include what instruments mean to people, how they are used, what symbolism they carry, and a host of other factors. The intention of the Lysloff/Matson team was not to create an overarching system such as H-S, but to present a method that can be used in individual case studies.

1989 Tellef Kvifte writes *Instruments and the electronic age* (Oslo: Solum Forlag). The value of this little-known book, with the subtitle "Toward a terminology for a unified description of playing technique" is the author's unified summary, with excellent diagrams, of all the major classification systems, from Mahillon to Galpin 1, H-S itself, Galpin 2, and Schaeffner. He also diagrams two lesser-known systems by Tobias Norlind (1941) and Kurt Reinhard (1960), and discusses Dräger and several others in great detail (p. 6-62). He then addresses his particular interest, playing technique and how to study it, in a manner that would thoroughly please Dräger.

1990 Margaret Kartomi publishes *On Concepts and Classifications of Musical Instruments* (University of Chicago Press). Kartomi is included here for the same reason as Kvifte, as an important reference for all of the classification systems noted above, plus several others that have not been itemized here.

1990 The UCLA publication *Selected Reports in Ethnomusicology* Volume VIII is devoted to "Issues in Organology." Edited by Sue Carole DeVale, the volume includes eleven chapters and is a must-read for all organologists. Particularly useful are the articles by Nazir Jairazbhoy, one noted earlier in which he explains the circumstances of the development of the Mahillon system (p. 67-80), and the other "An explication of the Sachs- Hornbostel instrument classification system" (p. 81-104). The volume also includes the first attempt (after Galpin, 1937) to construct a classification for electrophones, with H-S-style numbering, by Michael Bakan *et al* (p. 37-54).

1992 Geneviève Dournon writes the chapter "Organology" for Helen Myers' book *Ethnomusicology, an introduction* (Norton). At the time, Dournon was curator of the vast (ca. 8000-item) instrument collection at the Musée de l'Homme in Paris (a collection that has since moved to the new Musée du Quai Branly). The introduction and bibliography of her chapter constitute a brief but excellent overview of organology through the ages, as noted above. She also makes note (p. 252) of the efforts of the CIMCIM group (*Comité des Musée et Collections des Instruments de Musique*) to improve the usability of H-S for museums (published in the *CIMCIM* Newsletter, issues 1983-4, 1985, and 1987). See 2011 below.

The heart of Dournon's chapter, however, is her own revision of Hornbostel-Sachs. She presents the entire system, profusely illustrated with diagrams and photographs, and introduces several important changes. In 2000 she released the final version of her system in "Handbook for the collection of traditional music and musical instruments" (UNESCO Publishing, p.110-133). Her efforts are reflected in various details of K-Rev, as will be discussed further below.

2007 Jeremy Montagu publishes his book *Origins and development of musical instruments* (Maryland: Scarecrow Press). Although Montagu had proposed an alternative to Hornbostel-Sachs in 1971, he acknowledges the importance of H-S in this book, while advocating a few small changes. He also restated these ideas in an article entitled "It's time to look at Hornbostel-Sachs again" in the (hard to find) Polish journal, *Muzyka* (54/1, 2009, p. 7-28). The book, with a truly global scope, hundreds of pictures, and insights into myriad factors of importance in studying musical instruments, is of enormous value to all organologists.

2011 The MIMO (Musical Instrument Museums Online) Consortium releases its "Revision of the Hornbostel-Sachs Classification of Musical Instruments by the MIMO Consortium." This should be regarded as the official current version of H-S. It may be viewed on the website of CIMCIM (*Comité des Musée et Collections des Instruments de Musique*) at http://network.icom.museum/cimcim/resources/classification-of-musical-instruments. It will be discussed extensively in the course of this document.

The development of the Knight-Revision

The notion that I would undertake the task of revising Hornbostel-Sachs emerged during a 2007-08 seminar in organology. My students and I sought to catalog and classify the instruments in the newly-created Roderic C. Knight Musical Instrument Collection at Oberlin College. We used Dournon's presentation of Hornbostel-Sachs rather than the original. But many of the stumbling blocks of the underlying system remained, seeming to cry out for still more revision. By the time the class had ended, there were many hanging questions, but in the following two years, I continued the work myself to complete the 2010 version of this document.

The "Knight System for Musical Instrument Classification" as it was originally known, was presented as a booklet and conference presentation at the Niagara Chapter of the Society for Ethnomusicology in 2010. At the time I had not been following the work of the CIMCIM group, nor did I know about the MIMO subgroup noted above. But one year later the group released its revision of the Hornbostel-Sachs classification system as noted above. The MIMO document is clearly the product of much research and collaborative thought. Issues raised by Dournon and by Montagu are addressed and incorporated, all while maintaining the traditional H-S numbering. Electrophones are formally introduced and classified, their numbers beginning with 5. (The article "Classification" in the *Grove Dictionary of Musical Instruments*, 2nd ed. (Oxford, 2014, v. 1, 578-79) includes an overview of the document.)

However, perhaps not surprisingly, my own reaction to the MIMO-revision remained the same as my reaction to Dournon in the organology seminar. Hence this 2015 version of my original 2010 document. In preparing it, now called the Knight-Revision, rather than the Knight-System, all of the findings of the MIMO consortium have been considered, and references to the MIMO document will be found throughout.

For electrophones, I defer entirely to the definitive classification by Maarten Quanten, Tim Boon, and Clive Greated in the MIMO revision. It is my intent to include their entire system in a future edition of K-Rev, but until this is arranged, if one wishes to assign a K-Rev number to an electrophone, it will be necessary to consult the MIMO document, then simply replace the initial 5 with the letter E. A summary of this system is included below, on p. 10.

The Knight-Revision emerged originally to serve a collection, as has been the case for many others as noted above, but at the same time it is a system intended to be globally applicable, as in H-S. Whenever possible, references will be made to instruments in the RCK collection, which may be viewed online at www.oberlin.edu/libraries/digital/knight. A K-Rev number is assigned to every instrument in the collection, and the number may be searched, to see all instruments of a particular classification.

With the immovable rock of Hornbostel-Sachs now entering its second century, especially when bolstered by the MIMO revision, why might one persist with yet another revision? The intent of K-Rev is not to unseat Hornbostel-Sachs (an impossible task), but to take the basic principles and philosophy of Hornbostel-Sachs and subject them to a new logic, streamlining the terminology and incorporating new findings in the process. Even where no changes are needed, the quest remains to find suitable two- or three-word *organonyms* ("classification names") that can be used to quickly identify an instrument. Many are in common use already, such as "plucked lute, "barrel drum," "transverse flute," "bridge harp." In K-Rev the attempt is to put a good organonym at the heading of each entry.

K-Rev is a work in progress. Many changes have already been made since 2010. The ultimate synoptic chart, matching each H-S item with its K-Rev equivalent has not been prepared, but this would be a logical next step. In the meantime, I invite organologists to study this document and try it out as a classification tool. Questions will undoubtedly arise, and are welcome, as are any suggestions and additions. Please email me at rknight@oberlin.edu.

In the chart below, a synoptic view of the K-Rev system is presented. In it, some of the streamlining mentioned above may be readily noted. For example, anyone who has studied H-S knows that rattles fall under a broader category called "indirectly struck idiophones." It was Dournon who first dropped this overarching category, and K-Rev follows suit, resulting in the stand-alone subcategories of shaken and scraped idiophones. Similarly, in H-S the chordophones are first subdivided into simple vs. composite. Unfortunately the "simple" category includes such diverse instruments as the musical bow, stick zither, and even the piano, while the lutes and harps are more clearly defined. Dournon eliminated the simple/composite distinction and at the same time coined the much-needed organonym "variable tension chordophones." K-Rev embraces this approach also, but as may be readily observed in the chart, with significant reorganization of the major subcategories. In the discussion that follows, each decision that went into creating the Knight-Revision will be explained in detail.

The Knight Revision of Hornbostel-Sachs (K-Rev) in Overview

IDIOPHONE

Y1 Concussion
- 11 Plaque
- 12 Bar
- 13 Dish
- 14 Vessel

Y2 Struck
- 21 Plaque
- 22 Bar
- 23 Vessel

Y3 Stamped
- 31 Globe
- 32 Tube

Y4 Shaken
- 41 Vessel
- 42 Sliding
- 43 Solid
- 43.1 Sheet
- 43.2 Spring
- 44 Concussion
- 45 Sympathetic

Y5 Scraped
- 51 Organic (wood, gourd)
- 52 Manufact'd (metal, cloth, sandpaper)

Y6 Friction
- 61 Solid
- 62 Vessel

Y7 Plucked
- 71 Frame
- 72 Board

Y8 Blown
- 81 Wood
- 82 Metal

Y9 Deformed
- 91 Diaphragm
- 92 Blade

MEMBRANOPHONE

M1 Struck
- **11 One head, open**
- **11.1 Vessel**
- 11.11 Cylinder
- 11.12 Cone
- 11.13 Waisted
- 11.14 Barrel
- 11.15 Goblet
- 11.16 Vase
- 11.17 (other shapes)
- **11.2 Frame**
- 11.21 Circular
- 11.22 Polygonal

- **12 One head, closed**
- **12.1 Deep** (vessel)
- 12.11 Cylinder
- 12.12 Kettle
- 12.13 Barrel
- **12.2 Shallow** (frame)

- **13 Two heads**
- **13.1 Vessel**
- 13.11 Cylinder
- 13.12 Cone
- 13.13 Hourglass
- 13.14 Barrel
- 13.15 Ang. Barrel
- **13.2 Frame**

M2 Shaken
- **21 External strikers**
- 21.1 Opposed hemispheres
- 21.2 Hourglass
- 21.3 Frame
- **22 Internal strikers**

M3 Friction
- 31 One head
- 32 Two heads

M4 Sympathetic
(*mirliton*)

CHORDOPHONE

C1 Variable tension
- 11 No neck
- 12 Single neck
- 13 Forked neck

C2 Musical bow
- 21 Mouth resonated
- 22 Gourd resonated

C3 Pluriarc

C4 Harp
- **41 Strings-over**
- 41.1 Forked
- 41.2 Spike
- 41.21 String holder
- 41.22 Bridge harp

- **42 Strings-in**
- 42.1 Arched
- 42.2 Angled

C5 Zither
- 51 Stick or bar
- 52 Tube
- 53 Raft
- 54 Board
- 55 Box
- 56 Trough
- 57 Harp zither
- 58 Frame

C6 Lute
- **61 Plucked**
- 61.1 One piece
- 61.2 Multi-part
- 61.21 Neck attached
- 61.22 Spike
- 61.23 Half-spike
- **62 Bowed**
- 62.1 One piece
- 62.2 Multi-part
- 62.21 Neck attached
- 62.22 Spike
- 62.23 Half-spike

C7 Lyre
- 71 Bowl
- 72 Box

AEROPHONE

A1 Ambient (Free)
- 11 Slicing
- 12 Beating (bull roarer)
- 13 Whip (sonic boom)

A2 Blown
- **21 Open**
- **21.1 Edge (flute)**
- **21.11 Vessel**
- 21.111 No duct
- 21.112 Duct
- **21.12 Vertical**
- 21.121 No duct
- 21.122 Duct
- **21.13 Oblique**
- **21.14 Transverse**
- **21.2 Chamber-duct**
- 21.21 Simple
- 21.22 Vented
- **21.3 Corrugated pipe**
- **21.4 Siren** (pulsated)

- **22 Reed**
- **22.1 Free (Hard)**
- **22.2 Beating (Soft)**
- **22.21 Normally open**
- **22.211 Conical bore**
- 22.211.1 Single reed
- 22.211.2 Double reed
- **22.212 Cylindrical bore**
- 22.212.1 Single reed
- 22.212.2 Double reed
- 22.212.3 Free on pipe
- **22.213 Mouthpiece only**
- **22.22 Normally closed**
- 22.221 Split or crushed
- 22.222 Membrano-reed
- **22.3 Ribbon Reed**

- **23 Lip reed**
- **23.1 Narrow compass**
- 23.11 Fixed length
- 23.12 Variable length
- **23.2 Wide compass**
- 23.21 Fixed length
- 23.22 Variable length (fingerhole, slide, valve)

A3 Plosive
- 31 Closed, 32 Open

E Electrophones (from MIMO-revision: 5 Electrophones). Please refer to the online document for details: http://network.icom.museum/cimcim/resources/classification-of-musical-instruments. K-Rev numbers for electrophones begin with the letter E instead of the number 5, but are otherwise identical.

E1 Electro-acoustic instruments and devices
E11 Idiophones
E12 Membranophones
E13 Chordophones
E14 Aerophones
E15 Transducers

E2 Electromechanical instruments and devices
E21 Tone wheel
E22 Photoelectric
E23 Record/Playback devices
E24 Samplers
E25 Sound processing devices

E3 Analog electronic instruments, modules, and components (in MIMO, analogue)
E31 Sythesizers with vacuum-tubes or transistors
E32 Voltage control sources
E33 Other analog modules or configurations

E4 Digital electronic instruments, modules and components
E41 Synthesizers
E42 Control sources and interfaces
E43 Signal mixing, modifying, reproducing, and processing devices
E44 Samplers and sampling synthesizers
E45 Record/Playback devices
E46 Other digital modules, components, or configurations
E47 Modules communicating between devices/signal convertors

E5 Hybrid analog/digital configurations

E6 Software

Some Notes on the Presentation

Format: The original *Systematik* was formatted with indentations to show the hierarchy of subdivisions, a format that was not retained in later versions. K-Rev is indented, but not for every subheading, and without repeating the full numbers at each indentation. For example, here are the entries for dish-shaped concussion idiophones:

Y13 Dish (depth less than diameter)
Y13.1 Face-to-face
 .11 Wood (castanets)
 .12 Metal (**cymbals** of all sizes)
 .2 Back-to-back Played on the convex surfaces (spoons)

When fully spelled out, the numbers are assembled, as in these two examples:
wood castanets, Y13.11, and metal cymbals, Y13.12.

Items in Bold: Each number entry and its organonym are in bold. In addition, certain instrument names that have become generic terms are also printed in bold, as in **cymbals** in the example above.

Sources: Sources for the named instruments given as examples are listed by country at the end; if not listed, they are from the author's own knowledge, or from the many articles in the Grove Dictionary of Musical Instruments (GDMI).

Suffixes: In H-S, at the end of each major family is a list of numerical suffixes that can be added to a classification to give supplementary information. The most extensive set of suffixes is for membranophones, itemizing the methods by which drumheads are attached. The Knight-Revision uses suffixes in the same manner. Some H-S suffixes have been supplanted by a letter, some have been newly created, and the membranophone suffixes are retained intact. In some cases, an item covered by a suffix in H-S has been elevated in K-Rev to a numbered subdivision, as in plucked vs. struck box zithers. The suffixes in K-Rev are introduced individually where they apply, then summarized in the Suffix Glossary at the end of this document.

A note on corporeal sounds: What about the voice, handclapping, finger-snapping? The voice is an aerophone, of course – see the note about it under free reed, A22.1, p. 31. For the others, Dale Olsen coined the term "corpophone" (1987:5). Even though corporeal sounds are not made by actual instruments, their classification can be imagined: handclapping is a concussion idiophone (two equally sonorous parts struck together), similar to the dish shape, p. 12. The finger-snap, thigh-slap, and cheek-tap are all struck idiophones (not membranophones, because the skin is not stretched, even for the cheek tap, where the variable pitch is created by the size of the mouth opening). Not quite in the same league is stamping your foot on the floor. In this case the floor is the instrument – a struck idiophone, while the foot is only the beater.

The Knight-Revision of Hornbostel-Sachs

Y Idiophones Idiophones are instruments whose body itself, or some part of it, makes the sound. They are sometimes defined by what they are not: an idiophone does not have an air column to be set in motion directly, nor does it have a membrane or strings to set the air in motion. In general, idiophones are solid or hollow bodies with sonorous capabilities. They are divided into nine classes (the first number after the Y). It will be apparent, looking at the overview above, that six of the nine are essentially different ways of striking the instrument. For example, when a stick is drawn across a rasp, it hits the notches in succession. For the most part, the subdivisions of idiophones in K-Rev resemble those of H-S, with the first distinction made on shape, the next on material. But for the rasp (a variety of Scraped), the material is more important than shape, and thus these factors trade places in the hierarchy. It is envisioned that further subdivisions, especially based on material, might become necessary as study progresses, and these may be added to the system fairly easily. The order of materials established in Y12 below–wood, metal, stone– is only intended as a model; the numbers assigned are not reserved for these materials where they are not applicable.

One might divide idiophones between those that produce only one sound and those that are multi-pitched. The Hornbostel-Sachs system carefully denotes, with separate numbers, single-pitched items versus sets of the same. In K-Rev this is handled with a suffix. Instruments that are designed to produce more than one sound will have a suffix appended to their number, as follows: #n, where n is the number of notes it can produce. For example, the *gambang*, Javanese trough-resonated xylophone with 19 keys would be assigned the number Y22.121 #19.

Wachsmann observed, in his GDMI article on classification (2014, v.1:569), that when Hornbostel-Sachs first appeared in 1914, the readership must have been surprised at the number of idiophones and their variety, requiring many levels of differentiation. Galpin, having seen H-S, noted that for his system (Galpin 2), "such minute or appealing classifications as [those in H-S] will not be attempted" (1937:29). This is a good place to mention that the daunting long numbers (in H-S, or Dournon, or K-Rev) can always be scaled back to show less detail when it is not needed. For example, the full K-Rev number for the Japanese temple bell *bonsho* happens to be eight digits long: Y23.221.12 (deep metal bowl bell, directly struck), but it could also be correctly identified as Y23.2 (edge-struck vessel), and the details left for assigning to an actual instrument in a collection.

Y1 Concussion, or **clappers** (in German, *gegenschlag*): two equally sonorous parts are struck together. If a beater is used, it is *aufschlag*, or Percussion (see Y2).

Y11 Plaque A plaque is flat (thickness 1/5 or less of width), typically wood (*paiban*, China; *thiski*, Central India)

Y12 Bar A bar has thickness and width nearly equal, cross-section round or rectilinear.
- **.1 Wood** (*claves*, Latin America; *khartal*, India (often with jingles, and thus requiring a dual classification – see Y44.42 below)
- **.2** Metal (solid aluminum-rod wind bells, also known as a "mark tree" by percussionists)
- **.3** Stone (*ili ili*, Hawaii)

Y13 Dish A shallow object, with a depth less than the radius
- **.1 Face-to-face**
- **.11 Wood** (castanets)
- **.12 Metal** (**cymbals** of all sizes)
- **.13 Hands clapping**
- **.2 Back-to-back** Played on the convex surfaces (spoons)

Y14 Vessel A deep object, with a depth equal to or greater than the radius
- **.1 Hemisphere** (two coconut halves)
- **.2 Tube** (*wa* bamboo clapper, Myanmar; *hangar*, Philippines)

Y2 Struck, or "percussion" (Ger. *aufschlag*). A sonorous object is struck with a beater. In H-S the first binomial choice under struck idiophones is "struck directly or indirectly." Following the lead of Dournon, this distinction is dropped in K-Rev, creating instead the categories of Shaken and Scraped, below. The distinction between direct or indirect action remains important as a subset for certain types of struck instruments, as will be noted under Y21.2 and Y23.2.

Y21 Plaque A thin solid, with a thickness of no more than 1/5 of the next dimension
- **.1 Wood** (*han*, Japanese Buddhist temple instrument; *cartaxinho*, bamboo "woodpecker," Portugal)
- **.2 Metal**
- **.21 Directly struck** (*nyo*, Japanese Buddhist temple instrument; *crotales*, Western orchestral bell). The American musical saw, if played with a hammer (as it can be), would fall here. But it is designed to be played with a violin bow, and thus is a friction idiophone, Y61.1)
- **.22 Indirectly struck** (*Flexatone*, in which a plaque in a frame is struck by springy beaters when shaken)

Y22 Bar The thickness and width are nearly equal, cross-section round or rectilinear. Most bar instruments are sets, and should be identified as such by adding the suffix #n, where n is the number of bars (keys).

Y22.1 Wood – the xylophone

- **.11 Unmounted**, **or loose key** The parts are assembled for use, then dismantled (*amadinda*, Uganda) With 12 keys, the full number with suffix would be Y22.11 #12.
- **.12 Mounted (fixed key or frame)** The bars are attached to a frame.
- **.121 Common resonator** (trough or box) (*ranat*, Thailand; *gambang*, Java)
- **.122 Individual resonators** (*bala*, West Africa; Western xylophone & marimba). Instruments of this type from Africa and Central America usually have sympathetic (or to use Galpin's term, co-vibrating) membranes mounted on the resonators (see M4). If present, they should be indicated with the suffix -z, as follows: Y22.122 -z.

Y22.2 Metal (**metallophone**)

- **.21 No resonator**
- **.211 Directly struck** (triangle, anvil, Glockenspiel)
- **.212 Indirectly struck** (in the *Choir Chime*, a set of individual metal bars (Malmark), a spring-mounted beater strikes the bar when it is shaken.)
- **.22 Common resonator** (trough or box) (*saron*, Java; celesta, toy piano)
- **.23 Individual resonators** (*gender*, Java; all *kantilan* instruments, Bali; vibraphone). Note: for the vibraphone, add the suffix -e to identify the electrically-powered paddles inside the resonators that create its distinctive sound.

Y22.3 Stone (**lithophone**)

- **.31 Resting** (i.e., unmounted or loose key) (*picancala*, Kabiye people, Togo; *goong lu*, *dàn dá*, Vietnam)
- **.32 Hanging** (*te qing* or *bianqing* [set of 16], China; *p'yon-gyong* set, Korea)

Y22.4 Fiberglass (subdivided as for wood). An example is the bass bar used in music education classes: Y22.422 (fiberglass bar with individual resonator).

Y22.5 Bone The donkey jawbone *quijara*, used in Mexican music, is struck with the base of the palm. The vibration is inaudible, but it causes the front teeth, loose in their sockets, to rattle. The instrument is also played as a rasp, across the molars (see Y51.3)

Y23 Vessel. The principal distinguishing feature for this class is not the material, but the designation of where they are struck: the center, the edge, or anywhere on the top.

Y23.1 Center-struck (the Gong) The shape varies from a shallow pan to a deep pot, typically of metal, designed to be struck at the center, where vibration is greatest.

- **.11 Flat** A shallow pan with no knob or boss
- **.111 Hanging** (*luo*, China; Western orchestral gong)
- **.112 Resting** (or hanging horizontally), always with 2 or more tone-producing segments (multiple centers) sharing the face (steel pan, Trinidad; *hang* (see Hang, 2001 in References))
- **.12 Bossed** or knobbed: typically deeper than the flat gongs, these instruments have a raised area on the flat surface where they are struck.
- **.121 Hanging** (*kempul*, *gong*, Java)
- **.122 Resting** (*bonang*, Java; *trompong*, Bali; use the #n suffix for number of pots.)

Y23.2 Edge-struck (the Bell) Most bells are designed to be struck on or near the opening, where vibration is greatest, but some, especially of the globe shape, produce the same sound regardless of where they are struck.

- **.21 Globe** or pod (elongated globe) shape: closed at one or both ends, usually with a narrow slit opening. Rectilinear shapes are included.

Y23.21 Globe Edge-struck cont.

.211 Directly struck

.1 Metal (*frikyiwa*, Ghana)

.2 Wood or bamboo – the wood block and **slit drum** (*muyu*, Chinese temple block or fish bell; *keli*, bamboo with several parallel slots, Sierra Leone; *nunuha* [and three others] in the *Para ni 'o'o* ensemble, 'Are'are people, Melanesia; *teponaztli*, with H-shaped slot, Mexico; the American *Crow Sounder* (Y51.1) when struck)

.212 Indirectly struck globe, or **jingle bell** The Western jingle bell or pellet bell falls here when mounted or shaken in such a manner that the sound is produced only by the pellet striking the globe from the inside. When clustered, the jingle bell becomes a concussion rattle (see Y44.22 below).

Y23.22 Bowl, bell, or bullet-shaped. Closed at one end, open at the other.

.221 Directly struck

.1 Metal The depth varies and is noted with two sub-categories:

.11 Shallow dish (*shoko*, Japan; auto brake drum in a Trinidad steel band)

.12 Deep (*keisu, bonsho*, Japan; *qing, bianzhong*, China; *gankogui* double bell, Ghana; cowbell in Latin music)

.2 Glass or ceramic (*jalatarang*, India)

.3 (other materials may be added here and in others below)

.222 Indirectly struck, or **clapper bell**. A striker, or "clapper" is attached inside (or in rare cases, outside) the bell and strikes the bell edge when either the bell or the clapper is set in motion by manual or mechanical means. If mechanical, as in carillons with pull-ropes or a keyboard, or the celesta with keyboard, the suffixes -m (mechanical) or -k (keyboard) should be added. For example, a ten-bell carillon operated by pull-ropes would be Y23.222.1-m #10.

.1 Metal (*drilbu*, Tibet; Western "dinner bell" and bell-choir bells; Western carillon bells, with suffix –m or –k (see main Idiophone heading); European livestock bells.

.2 Wood (opposed double bell, Bali; cowbell, Ethiopia; animal bell with external clappers – see Dournon 1992:269)

Y23.23 Tubular Usually open at both ends

.231 Side-struck (*neo*, Gambia; *karinya*, Guinea; *toke*, Ghana; *ogan*, Haiti)

.232 End-struck (Western orchestral tubular bells ("chimes") – the striking end is thicker, and may be closed.

Y23.3 Top-struck, or <u>non-bell</u>. Struck virtually anywhere on the flat or convex top.

.31 Wood or bamboo (*jegog*, bamboo xylophone, Bali)

.32 Clay (*ghatam*, South India)

.33 Gourd (*horde*, *ji dundungo* ("water drum"), both half calabashes, the latter floated on water, W. Africa)

.34 Plastic (inverted tub or bucket, played by street musicians)

.35 Metal (*hpà-si* bronze drum, Myanmar and formerly other areas in SE Asia, Indonesia, and China). This singular instrument, with a squat hourglass shape and flat top, is struck on the top. It does not vibrate like a gong, however, but like the membrane (or diaphragm) of a drum (See Montagu 2007, p. 39, 212, 220). Thus the popular name for it, "bronze drum," is correct.

Y3 Stamped (or tapped) The instrument itself is struck on the ground (or tapped on the hand or thigh). Note: if a solid object, such as the *megomiya* staff used in the Ethiopian Coptic church, is stamped on the floor, it is functioning merely as the beater, not an instrument.

Y31 Globe Typically made of a gourd (*ipu ipu*, Hawaii; *bollo*, FulBe people, Gambia)

Y32 Tube (Stamped cont.) Typically bamboo (*tamboo bamboo*, Trinidad; *au ni mako*, 'Are'are people, Melanesia; *quitiplas*, Venezuela. Both the *shantu* and the *quitiplas* are also typically played with a plosive aerophone technique, earning them a dual classification (see A32.2).

Y4 Shaken – the rattle In H-S, the rattle is one variety of "indirectly struck" idiophone. In K-Rev, following the lead of Dournon, this overarching category is dropped, to be used only as noted above as a subset for certain types of Y2 struck idiophones.

Y41 Vessel rattle A vessel, usually with a handle, is shaken to cause strikers to hit it.

- **.1 Internal** (**Maracas** type). The strikers (seeds, beads, buckshot, etc.) are inside the vessel; when shaken, they are thrown against the inside surface.
- **.11 Gourd** (*saka*, Suriname; Native American rattle)
- **.12 Wood** (*maracas*, Mexico; Tlingit rattles, Pacific Northwest)
- **.13 Cow horn** (Native American rattle)
- **.14 Turtle shell** (Native American rattle)
- **.15 Bamboo** (the rain stick, originally from Central Africa)
- **.16 Basket** The vessel is made of woven plant material (double baskets, Cameroon; cylindrical basket, Saramaka people, Suriname)
- **.17 Metal** (metal shakers, India, Central America)
- **.18 Plastic** (egg shaker)

Y41.2 External In the "external-bead rattle" the strikers are strung on a net on the outside of the vessel, invariably a gourd (*axatse*, Ghana; *shekere*, Nigeria; *segbureh*, Sierra Leone; half-calabash rattle, Cameroon)

Y42 Sliding-tube Tuned bamboo tubes hang in a slotted frame, sounding as the frame is shaken back and forth and they hit the ends of the slots (*angklung*, Bali)

Y43 Solid A material (usually metal) produces a sound when moved by shaking. Jearl Walker, in *The Flying Circus of Physics* (Wiley, 2007) explains the sound as an *aeolian tone* created when the material "sheds vortexes" [picture a smoke ring], creating air pressure changes, and thus a sound (§3.2, Singing of telephone wires, p. 147).

- **.1 Sheet or plate** A rigid but flexible sheet, usually of galvanized metal, is deformed by shaking (theatrical **thunder sheet**). Note: a thunder sheet may also be struck, but it remains the shaking of the metal that produces the distinctive sound. (In the MIMO revision, this instrument is accommodated under the new category 15, metal sheets, but other shapes have similar characteristics, as noted in the next item.)
- **.2 Spring or wire** A straight or tightly-wound wire (a spring) is shaken, producing a sound. In the *Thunder Tube*, the spring is attached to the membrane cover of a tube for resonance, but unlike the friction drum (see M31), the membrane does not determine the pitch.

Y44 Concussion rattle – the **jingle**: quantities of similar or identical objects clash against each other when shaken.

- **.1 Paired** Two items connected; shaken or twirled (*bakicha* fruit shells, Gambia). In this category also falls the split idiophone *balingbing* (Philippines), made of a length of split bamboo. When hit on the palm, the edges of the split vibrate against each other, producing a short sustained tone.
- **.2 Cluster** Numerous items are connected to strike each other when shaken
- **.21 Organic** (*chajcha* deer hoof rattle, Bolivia; spider egg case, Huichol, Mexico)
- **.22 Manufactured** In various shapes (*ghunguru* pellet bell clusters worn by dancers, India; clusters of two or more pea-pod shaped bells worn on wrists of drummers and xylophonists in West Africa; *jagar*, jingles mounted atop a stick, Baiga people, Central

India; the "Turkish Crescent;" *Kanyelango* cap, Gambia; small rolled metal cones sewn on American Indian dance dress.) See Y23.212 above for the single jingle bell.

Y44.3 Row (Concussion rattle cont.) Elements are strung in a row to sequentially hit each other when moved (*bin-sasara*, Japan)

.4 Frame (the sistrum or frame rattle) Items strung on wires or posts strike each other when shaken. (They may also strike the frame in which they are mounted.)

.41 Organic (*wasamba*, *lala*, seed or calabash chips threaded on a forked or curved stick, West Africa)

.42 Manufactured (*tsenatsil*, with metal discs, Ethiopia; the metal discs on the *khartal* concussion idiophone, India; the jingling discs on a tambourine; *chimta* "tweezer" jingle, India)

Y45 Sympathetic. Galpin's term is "co-vibrating" (1937:74). Similar to the *mirliton* or kazoo (see M4 below), this is <u>not an instrument *per se* but only a sound modifier</u>. The form, typical in Africa, is a metal plate with metal rings threaded in holes around the edge. It is attached to an instrument and vibrates in sympathy with it (*nyenyemo* for the *kora*, Mande people, West Africa; similar mechanism on many drums and some lamellaphones). The jingles on a tambourine may also function this way: if not shaken, they still sound in sympathy with the struck head. The suffix -s may be added to a classification number to indicate the presence of Y45 on an instrument.

Y5 Scraped – the rasp A notched <u>or</u> rough surface is rubbed with an implement. In defining the scraped idiophone (Ger. *Schrap* or in the Langenscheidt dictionary, *Schab*), Hornbostel and Sachs describe the repeated hitting action of an implement scraped over notches (another variety of "indirectly struck." The definition needs to be expanded to include not only notches but rough surfaces as well (see Y52 below) in order to accommodate instruments that might otherwise be mistakenly classified as Y6, Friction. In keeping with H-S, the term friction is reserved for those instruments in which a rubbing action sets up a harmonic vibration (i.e. a sustained and measure-able tone). It is worth noting that a number of scraped instruments are intended to be struck as well, which necessitates a dual classification. The *Crow Sounder*, Y51.1 below, is an example.

Y51 Organic

.1 Wood [cane, bamboo], notched: (*guacharaca,* Colombia; *Crow Sounder*, USA (intended to be both scraped and struck, and thus dual-classified as Y23.211.2; see also the *quijara*, donkey jawbone, Y22.5 and Y51.3); *matraca* twirled cog-wheel, Mexico (with suffix -m for mechanical)

.2 Gourd, notched: (*guiro,* Dominican Republic)

.3 Bone The donkey jawbone *quijara*, struck to rattle the front teeth (see Y22.5), is also played as a rasp across the molars, and thus demands a dual classification.

Y52 Manufactured

.1 Metal

.11 Scraped with a rod (*guira,* Dominican Republic; *grage*, Haiti)

.12 Scraped with beads (*cabasa*, metal cylinder encircled with beads, twirled in hand)

.2 Cloth A cylindrical cage of sticks is turned by a crank to rub against the inner surface of a cloth surrounding it (theatrical **wind machine**). Montagu notes that Hornbostel and Sachs apparently overlooked the wind machine and suggests including it (following J. Blades in GDMI) as an idiophone (2007:212). However, this is incorrect. The rough surface dictates a description as scraped, not friction. See Y5 and Y6 for clarification of this point.

.3 Sandpaper This is an example of a rough (rather than notched) surface producing the sound (sandpaper blocks rubbed together).

Y6 Friction A smooth surface is set in harmonic motion by rubbing, producing a measurable tone. The H-S sub-categories are replaced by the following:
Y61 Solid
.1 Plaque or plate [i.e. flat] (American musical saw, played on edge with a bow)
.2 Bar or stick (nail violin; the *Euphon* and *Klavizylinder* of Chladni, 1790s – see GDMI). All are multi-toned and would have the appropriate # suffix, plus -k for the latter two, with keyboards.

Y62 Vessel or Hollow
.1 Center- or top-friction
.11 Wood A block with a slotted top and cavities below is rubbed on top to produce three tones (*nunut*, *launut, livika,* New Ireland Island, Papua New Guinea – see *Musikgeschichte in Bildern* I/1)
.12 Tortoise shell (*serakuata*, Guaymí people, Panama – Brandt & Velasquez, 1979)
.2 Edge-friction
.21 Gourd (*dummbo*, the open edge of a half calabash is scraped on a stick resting on the ground, FulBe people, Cameroon)
.22 Metal The bowl bell *qing* (China) or *keisu* (Japan) [see Y23.22] when striker is rubbed on the edge, today commonly called the "singing bowl." A dual classification is suitable if both techniques are used on a particular instrument.
.23 Glass (ordinary wine glass; the *armonica* or "glass harmonica" of Benjamin Franklin, 1761 (see GDMI, "Musical glasses")

Y7 Plucked (Lamellaphone) A tongue fixed at one end is plucked on the free end.
Y71 Frame The mouth harp or trump: a single tongue is cut from or mounted in a frame. Its single tone is resonated with the mouth of the player to produce trumpet-like overtones (hence the name "trump," promoted by Montagu). The practice of breathing past the vibrating tongue while playing raises the question of its dual identity as an aerophone (Crane 1968, Adkins 1974).
.1 Bamboo or cane The tongue is cut from the frame, and thus termed "idioglot." The term is also used for certain reed aerophones, and is indicated with the suffix –i, but in this instance it is redundant, since it is a given (*genggong*, Bali).
.2 Metal The tongue is a separate piece attached to the frame, thus "heteroglot." (*kach-tehendor*, Muria people, Central India; Western mouth harp).

Y72 Board (the mbira) A set of tongues is clamped on a board or box for resonance
.1 Bamboo (some old instruments from Central Africa)
.2 Metal (*mbira*, Zimbabwe; *kondi*, Sierra Leone; *marimba* or *marimbula*, Dominican Republic & Jamaica; Western music box, with suffix –m for mechanical action). Note: It is of interest that Elisha Gray, Oberlin College student and later faculty member, and contemporary inventor of the telephone with Alexander Graham Bell, created one of the first electrophones in 1876 with a lamellaphone. His Musical Telegraph, with a keyboard, used electromagnets to set steel reeds oscillating, and the sound could be transmitted by telegraph. (http://120years.net/the-musical-telegraphelisha-greyusa1876/, accessed 2/19/2015)

Y8 Blown. This category is inhabited solely by two experimental 19th-century bellows-operated keyboard instruments in which air was directed to free-standing thin bars ("sticks" or "plaques" in H-S) to set them in motion. These could actually be regarded as air-activated lamellaphones.
Y81 Wood sticks (*Aeolsklavier* of Schortmann, 1820)
Y82 Metal plaques (*piano chanteur* of Baudet, 1875)

Y9 Deformed This category has been added to accommodate instruments that are decidedly toys, but as humanly-made sound producers, qualify for classification. They are made of a stiff material (usually metal) that makes a sound when deformed.
Y91 Flexed diaphragm (in MIMO-revised H-S, 16). A convex disc is deformed by pulling on a string at the center, causing it to make a "clucking" sound.
Y92 Flexed blade. A short length of spring steel is attached at one end to a frame with a resonator. When the other end is flexed by the thumb, the metal deforms, then snaps back creating the "cricket" sound.

M Membranophones Membranophones are drums, with a membrane (the skin, or head) stretched over an opening. The sound is produced by setting the membrane in motion. As in idiophones, the principal subdivision is based on how this is done. For membrano-phones, there are four classes. The first three – struck, shaken, and friction – are true sound-producing instruments, while the fourth, included in H-S as "singing membrane" and retained here, is only a sound modifier that vibrates in sympathy with another sound – in a word, the *mirliton* or kazoo (see M4).

In H-S, the first subdivision (of struck, for ex.) is by shape (vessel, tubular, frame), with further distinctions following, including the number of heads. This results in six- to eight-digit numbers for virtually every instrument. In K-Rev, following the lead of Dournon (1992:272-3), but with a slight variation, the first subdivision is by number of heads: one head open, one head closed, two heads, with shapes following. There are two reasons for ordering the membranophones thus: (1) the number of heads is typically the first item of interest on a drum, and (2) the K-Rev numbers are only 5-6 digits.

The internal shape of drums is not noted in H-S, nor is it in K-Rev, but where it is significant, it may be noted as a subcategory to be added under the external shape. The material of the body, important in idiophones since it makes the sound, is a lesser subcategory for membranophones.

In H-S, a drum with a handle is assigned a separate number. In K-Rev, this is indicated with the suffix -h. The presence of a snare – a cord stretched diametrically or tangentially across the drumhead – may be indicated with the suffix -x. Details of playing technique for membranophones are not included in H-S, but in K-Rev may be indicated with a set of suffixes (following after the -h or -x where used), as follows: -1, played with one stick; -2, played with two sticks; -3, played with one hand; -4, played with two hands; -5, played with stick-and-hand. If the technique regularly includes hitting the drum shell with a stick, as in the Ghanaian *atsimewu* or the Korean *puk*, a dual classification as idiophone should be given. The H-S suffixes for describing the attachment of the drumhead to the shell are retained in K-Rev. They conveniently begin with the number -6. Finally in K-Rev, a suffix indicating the thickness of a drumhead may be added where significant, as follows: -a for thin, -b for medium, -c for thick. All suffixes are compiled in the Suffix Glossary at the end of this document.

M1 Struck The membrane is struck by stick or hand or both.
M11 One head, open shell

- **.1 Vessel** The depth of the shell is equal to or exceeds the radius
- **.11 Cylinder**
- **.111 Straight**
- **.112 Cut-away, or footed** The shell has cut-away sections at the bottom and rests on the "feet" between them
- **.12 Cone, truncated** The open end is smaller than the head (Western bongo drum)
- **.13 Waisted** The diameter narrows at the center (*wasikor*, Papua New Guinea)
- **.14 Barrel** The diameter increases at the center (*atsimewu, kidi, kloboto*, Ghana; Western conga drum)

M11.15 Goblet (One head, open shell, struck vessel membranophone cont.) The diameter cuts in below the head, then flares again at the base (*darabukka*, N. Africa; *dombak*, *zarb*, Iran; *jembe* or *djembe,* Guinea)

.16 (other shapes may be added)

M11.2 Frame The depth of the shell is less than the radius

.21 Circular (*bodhran*, Ireland; American Indian drum; Western **tambourine** (also Brazilian *pandeiro*), with frame jingles Y44.42 attached; *tchauyuk* handle drum, Yupik people, Alaska) The last is unusual: the player usually hits only the frame, but the predominant sound still comes from the head.

.22 Polygonal (*gome* square drum, Ghana; octagonal drum, Salish, Pacific NW Indian)

M12 One head, closed shell (the Kettle), in various shapes (see Montagu 2007:213)

.1 Deep Equivalent to vessel, above.

.11 Cylinder (*tabla*, India - the internal shape is cylindrical, even though the shell may be thicker at the base)

.12 Kettle The shell is rounded at the base, with varying dimensions (*tinde* [a mortar with tanned goatskin], Tuareg, Niger; Western kettle drum)

.13 Barrel As with the kettle, the shell is rounded at the base, but curves in at the head, i.e., the head diameter is smaller than the maximum shell diameter (*bayan*, India; *benda* full-gourd drum, Mossi people, Burkina Faso)

.14 (other shapes may be added)

.2 Shallow Equivalent to frame, above: the depth of the shell is less than the radius (*timki*, *kundir*, Central India)

M13 Two heads

.1 Vessel The depth of the shell is equal to or exceeds the radius

.11 Cylinder (*davul*, Turkey; American Indian drum)

.12 Cone, truncated (*bata*, Nigeria)

.13 Hourglass The shell is dramatically smaller at the center

.131 Fixed pitch (*ko-tsuzumi*, Japan; *parrai*, Muria people, C. India)

.132 Variable pitch, by squeezing the cords (*o-tsuzumi*, Japan; *donno*, *tama*, West Africa (the "**talking drum**")

.14 Barrel The diameter at center is larger than the heads

.141 Symmetrical The widest diameter is centered (*dholak*, India)

.142 Asymmetrical The widest diameter is offset (*kendhang*, Java; *mandar*, India; *maddal*, Nepal)

.15 Angular barrel: the widest point is an obtuse angle rather than a curve (*mridangam*, India)

.2 Frame The depth of the shell is less than the radius. Two-headed frame drums are always circular (*rnga* handle drum, Tibet; shaman handle drum, Nepal; both to have the -h suffix for handle drum)

M2 Shaken Always two-headed, the heads are struck by objects when the drum shell is set in motion.

M21 External strikers (the rattle drum) Two pellet-tipped strings are attached to the body in such a manner that when the drum is twirled, the pellets strike the heads.

.1 Opposed hemispheres (dual cranium drum, Tibet)

.2 Hourglass, with variable tension (*damaru*, India)

.3 Frame or barrel, with handle (shaman drum, Korea)

M22 Internal strikers Tiny pellets by the thousands are enclosed inside the drum. When set in motion, they tumble and strike the head (*Ocean Drum* by Remo).

M3 Friction The head is set in motion by a string or stick attached to or in contact with the head. The presence of a string or stick does not translate to a chordophone or idiophone; rather, it is a coupled system, similar to reed coupled to bore length on an aerophone. The pitch of the sound produced by the friction is determined by the size and tightness of the head. (In H-S a separate class (233) is given for drums in which thumb friction is used on the head. This is not included in K-Rev because it is never the sole technique on a drum but rather an alternative technique used on various hand drums.)

M31 One head friction drum

- **.1 Internal** The string or stick is attached to the drumhead inside the shell. The player reaches inside to pull on the string or rub the stick back and forth (*cuica*, Brazil; *moukouiti*, Ba-Lari people, Congo Brazzaville)
- **.2 External**: the string or stick is in contact with the outside surface of the drumhead.
- **.21 Hand-rubbed**: wetted fingers pull on the stick (*zambomba*, Spain)
- **.22 Twirled**: a string attached to the drumhead is attached at the other end to a wooden handle. As the drum is twirled around the handle, the friction of the string on the handle transmits a vibration to the head (*Waldteufel* ("forest devil"), Germany)
- **.23 Stick-rubbed**: a stick is attached to a cord stretched across the head and is rubbed on the head (*furruco*, Venezuela – see Aretz 1967:101)

M32 Two head friction drum A cylindrical drum with a string attached to each head (Senufo, Ivory Coast – see Dournon 1992:271)

M4 Sympathetic (Galpin's "co-vibrating") – the *mirliton* or kazoo. The kazoo or singing membrane is not an instrument – it only modifies another sound. Nevertheless, it is a man-made mechanism for use in sound production, whether it be the impromptu paper-and-comb variety or the device used for voice disguise by African masked dancers. Hornbostel and Sachs included it, and their categories are maintained here, coincidentally, with matching numbers. In addition, if such a mechanism is part and parcel of another instrument, as in the resonator membranes of the West African *bala* or *balafon*, or the membrane-covered hole on the Chinese *dizi* and Korean *taegum* flutes, it should be so identified with the suffix -z for those instruments.

M41 Free The membrane is set in motion directly, without the air first passing through a chamber (comb-and-paper)

M42 Tube or vessel. The membrane is mounted in the wall of a tube or box; the person sings into it (kazoo; voice disguiser for African masks)

C Chordophones Chordophones are instruments with a string or strings stretched over the body. Setting the strings in motion produces the sound. For chordophones, the method of setting the string in motion (i.e., the playing technique) is not the primary choice as it is for the idiophones and membranophones. Instead, body shape and string alignment are prime. In H-S, the first binomial choice is "simple" versus "composite." The problem is that zithers, no matter how complex, fall under the "simple" category, separating them from their close relatives, the lutes and lyres. Also, the musical bow in H-S is treated as a variety of bar zither, with the straight-bodied variety being called "stick." Both the terminology and the hierarchy become quite confusing. For this reason, in much the way Dournon treats chordophones, in K-Rev the simple/composite choice is dropped and replaced with a simple list of body types. As Dournon notes, the first benefit is that the numbers are all shorter, but more importantly, the most salient construction details for distinguishing one chordophone from another become the first choice. Dournon identifies nine types, ending with her variable-tension chordophones. In K-Rev there are only seven, because two of her types (harp lute and harp zither) are subsumed into harps and zithers. Also, I chose to start the K-Rev list with her variable tension chordophones, but in other respects our separations/groupings are similar. Playing technique remains as a subheading except in the lute category, where in K-Rev (as in Dournon) it assumes top prominence, separating plucked from bowed.

A list of numbered suffixes is given in H-S for chordophones, but these are abandoned in K-Rev, to be replaced with a different list, as follows: -d, cranked disc action (as on the hurdy-gurdy); -k, keyboard; -f, frets on the fingerboard; -mm, membrane-faced where not the norm; -w, wood-faced where not the norm, and #n (noted earlier for idiophones), to give the number of strings, when relevant.

C1 Variable tension. One reason to place this organonym, coined by Dournon, at the top of the list is that we might imagine such instruments as the first ever chordophones. The pitch is changed by varying the string tension, either by direct pulling or by a mechanism such as an arm or a neck. This is the instrument given the misnomer "plucked drum" (22) by Hornbostel and Sachs, which has since been dropped from the system. It is decidedly a chordophone; the membrane is only a resonator. There are three types, all plucked.

C11 No neck A string with a handle at the loose end is attached to the head of a small drum. With the drum tucked under one arm, the string is pulled to vary the pitch (*ananda lahari*, India).

C12 Single neck The string is attached at one end to a diaphragm of wood, metal, or hide. At the other end it is attached to a stick. If the stick is straight, pulling on it raises the pitch (washtub bass, USA); if it is curved, pulling on it lowers the pitch (archaic earth bow, Africa; *tiki berenge*, Burkina Faso); the arm of the Vietnamese *dan bau* can be moved in either direction.

C13 Forked neck The string is attached to the underside of a small drumhead and extends out the open end between two flexible arms in the shape of a V. Squeezing the arms lowers the pitch (*gopi yantra*, India).

C2 Musical bow A stick is pulled into a bow shape by the tension of a string, or in some cases, more than one string (the latter to be indicated with the #n suffix, as for idiophones). By whatever playing method, in all the fundamental tone of the string is sounded, then the overtones are isolated, in most cases resulting in a melodic line above the fundamental. In H-S, the musical bow is designated a curved variety of bar zither (311.1), with the straight ones being called stick zithers (311.2). It is much simpler to treat musical bows as a separate entity. Bows are of two types, mouth-resonated or gourd-resonated. Hornbostel and Sachs went to great pains to include many varieties of idiochord and heterochord bows and stick zithers. These details have not been replicated in K-Rev, but could be included as subheadings in the future.

C21 Mouth-resonated musical bow The instrument is held near the face and a tone produced by striking, bowing, or plucking the string. Overtones are isolated by different means.

- **.1 Proximity resonation (mouth-resonated musical bow cont.)** The player holds the string near parted lips and taps it with a thin wand. The other hand stops the string to produce a second fundamental. Forming the lips into different vowel sounds isolates harmonics to produce a melody over the fundamental tones (*koningei,* Sierra Leone, *kankarma*, Burkina Faso; *mungongu*, Gabon; Nahuatl bow, Mexico).
- **.2 Contact resonation** The player holds the back of the bow with the mouth. Most of these instruments are obsolete, but the first two were included by name in H-S:
- **.21 Plucked** (*kalove*, with two strings, Guadalcanal, Solomon Islands)
- **.22 Struck** (*pagolo*, with two strings, one with a tuning loop, Papua New Guinea)
- **.23 Rubbed** A stick or stretched string is rubbed on the bow to produce a sound.
- **.231 On the string**, i.e., "bowed" (*umqunge*, Xhosa people, Swaziland)
- **.232 On the notched wood** surface of the bow, i.e., scraped (*chizambi*, Zimbabwe)

C22 Gourd-resonated musical bow A gourd hemisphere (or greater) is attached "back to back" on the outside curve of the bow. The opening of the gourd is pressed or released from the player's body to isolate different overtones. There are two types: open or divided (formerly known as "braced"). In the second of these, the string is divided into two unequal segments by a length of twine that pulls the string toward the gourd so that two tones may be produced. All are struck.

- **.1 Open string** (*uhadi*, Xhosa people, *ugubhu*, Zulu people, S. Africa; *mbítí* two-string bow, Ba-aka people, Central African Republic. In this instrument, the resonator is a large leaf rather than a gourd.)
- **.2 Divided string** (*makhweyane*, Swaziland; *munahi*, Hutu people, Rwanda; *berimbau*, Brazil; *malunga*, Sidi people, India). Note: In the original German, the divided bow was described as *Mit Stimmschlinge* ("with tuning noose.") Stemming from the 1961 English translation, this type acquired the nickname "braced." The term may have been coined by Hugh Tracey and presumably stems from the old word for suspenders, or "braces," since the loop of twine hooks over the playing string a bit like a suspender over a shoulder. Given the obscure nature of this simile in the 21st century (at least in the U.S.), K-Rev recommends dropping the term "braced" in favor of "divided."

C3 Pluriarc A set of bows, each with its own string, attached to one resonator. Hornbostel and Sachs deemed this instrument a lute and called it "bow-lute." It does vaguely resemble a lute in the sense that the strings form a plane slanting up from the top surface of the body (and thus approximately in the parallel orientation that defines a lute), but agreeing with Dournon, I prefer to put this instrument, unique in construction and unique to Africa, in its own category, and I prefer the original French organonym for it: *pluriarc*, meaning "multiple bow." (*ndang*, Bambara people, Mali; *nsambi kizonzolo*, Ba-Lari people, Congo Brazzaville; *ngwomi*, Mitsogho people, Gabon). All are plucked.

C4 Harp The defining feature of a harp is that the plane of strings, which may be envisioned as a piece of paper lying flat on the strings, is perpendicular to the sound table or top surface of the body. Another feature is that the strings are played "open," i.e., they are tuned to the pitches needed and not altered by stopping the strings with the fingers to change the playing length. All harps are plucked.

The harp is often regarded as a development of the bow or the C12 variable-tension chordophone. The terms "arched" and "angled" are typical for harps, but another binomial choice is introduced in K-Rev to better accommodate the many configurations of harps. The question is: do the strings, standing in their perpendicular plane above the body, actually pass over the body without touching, or are they anchored in the body? The terminology is "strings-over" or "strings-in."

C41 Strings-over harp The strings are aligned vertically over the body but do not touch it.

- **.1 Forked harp**: the strings are stretched between two arms in a V or U shape, with a body mounted at the bottom (*towa*, Sierra Leone; *do*, Guéré of Ivory Coast; *juru,* Baule of Ivory Coast; *waj,* Nurestan in Afghanistan). This type of instrument is identified in H-S (and in MIMO-revised) as a "frame zither" (316).
- **.2 Spike harp** This organonym was coined by Sue Carole DeVale in 1989. A stick or pole pierces the body to form both the neck and tailpiece. All are membrane-faced.
- **.21 String holder harp** The strings are stretched between the neck and a second entity, the string holder, standing upright on the sound table. The neck is usually curved (*bolon* and *simbingo,* Mande people, W. Africa).

C41 Strings-over harp cont.

.22 Bridge harp The strings pass over a tall bridge. The neck is usually straight. The term replaces the H-S term "harp lute" (see Knight, 1971). The reason for the new term is to clearly define the instrument as a harp with a lute feature, namely, the bridge. The open-string playing technique also confirms its harp identity (the old term could have been interpreted as a "harp-type-of-lute," which it is not. (*kora*, Mande of W. Africa; *seperewa* [with curved neck], Ghana). Note: In MIMO-revised H-S, the traditional harp lute number of 323 is retained, but the terminology is improved: spike harp with tall string holder, or further differentiated as 323.2, spike harp with pressure bridge.

C42 Strings-in harp This is the more familiar harp configuration. The strings are stretched between the neck and the string holder (usually a second entity) that is mounted in, on, or behind the sound table. Most harps of this type are membrane-faced.

- **.1 Arched harp** The neck curves toward the face of the instrument. Three construction types were identified by Wachsmann in 1964 and are incorporated here:
- **.11 Spoon-in-a-cup** The neck rests inside the resonator, pulled into place by the strings (*ennanga*, Uganda; *saung-gauk*, Myanmar; bin-*baja*, C. India). In the last of these, the neck and string holder are one and the same, rather than two pieces (see Knight 1985). Also, the *bin-baja* typifies a variety of arched harp called "bow harp" (see GDMI 2014, v.1, p. 400) to identify an instrument whose neck curves only slightly rather than arching up over the sound table.
- **.12 Cork-in-a-bottle, or tanged** The neck is inserted in a socket in the body (*kinde,* Lake Chad region, W. Africa).
- **.13 Shelf** The neck is attached to a shelf at the back of the body (*ngombi,* Gabon)
- **.2 Angled harp** The neck forms an angle with the body, or incorporates an angle (as between a tree stem and branch) rather than forming a smooth curve. Membrane-faced is the norm.
- **.21 Open** (no pillar)
- **.211 Spoon-in-a-cup** (*ardin,* Mauritania; harps of ancient Egypt)
- **.212 Cork-in-a-bottle** (various, Central Africa; ancient Mesopotamia and Assyria
- **.213 Shelf (***gonfi*, Gabon)
- **.22 Pillar** The extremities of body and neck are joined by a third member, the "pillar" (all European harps, from troubadour to Irish to concert harp, with -w suffix to note the wood-faced body).

C5 Zither The strings are stretched from end to end of the body – there is no neck. The string plane is parallel to the sound table or top surface. The first three types (stick, tube, and raft) may be (or may have been in the past) idiochord, meaning the strings are cut directly from the surface of the body. If an instrument has this feature, it should be indicated with the suffix -ic. Without the suffix, heterochord (with separate strings attached) is assumed. The other zither types and indeed all other chordophones are heterochord. The norm for zithers is wood-faced. Some types have subdivisions for playing technique: plucked, bowed, or struck.

C51 Stick or bar In H-S, these are the straight-necked versions of the musical bow. Most are plucked, but two African instruments are assigned to a separate category for being blown.

- **.1 Plucked** (with or without attached gourd resonator). This category includes zithers made of a round-section stick that happens to be hollow but does not contribute to the resonance (*kinnari*, *bin* (old form of the *vina*), India. If the hollow body contributes to resonance, it is a tube zither, C52.
- **.2 Blown** The string is set in motion by blowing on a flat blade attached at one end of the string and held close to the lips in the manner of the ribbon reed (see A22.3). Unique to Africa: *gora* (Khoi Khoi people of South Africa), *lesiba* (Sotho people of Lesotho).

C52 Tube Zither The body is a tubular shape

- **.1 Body-alone** The tubular body alone is the resonator
- **.11 Idiochord** (guntang, Bali; *cing boong rlaa*, Mnong Gar people, Vietnam; early *valiha*, Madagascar)
- **.12 Heterchord** (*valiha*, Madagascar). Note: the *marovany*, a box-shaped variant of the *valiha*, is a box zither, C55.
- **.2 Added resonator**: gourds or other hemispherical objects are attached to the tube for additional resonance (modern *rudra vina* or *bin*, North India)

C53 Raft The body is made of small canes bound together as a raft. It is usually idiochord, with the strings cut from the surface of the cane itself and raised under small bridges (*hanhye*, Mahi people, Benin; unnamed, India (as pictured in Fox-Strangways). For clarity, the idiochord nature may be indicated with the suffix -ic.

C54 Board The strings are stretched from end to end of a board. As in the H-S designation, the ground may be counted as such. (May be subdivided by presence or absence of a separate resonator.) Note: An excellent observation in the MIMO-revised H-S is that the modern piano is actually a board zither (314) because the bottom (or in the case of an upright piano, the back) is open. But the earlier fortepiano and the clavichord are built with a box resonator below the sound table and are thus box zithers (see C55).

C55 Box The strings are mounted on the top surface of a box.

- **.1 Convex-top** (in H-S, these are termed "half-tube" zithers)
- **.11 Plucked** (*qin*, *zheng*, China; *koto*, Japan; *kayageum*, Korea)
- **.12 Bowed** The strings are rubbed with a rosined stick or bow (*komungo*, Korea)
- **.2 Flat-top**
- **.21 Plucked** (*zither*, Germany; autoharp, harpsichord; *kanun*, Turkey, with suffix -mm to denote the membrane-covered bridge section of the sound table)
- **.22 Bowed** Zithers played with a bow are most often bowed lutes that happen to have a hollow neck that would thus be deemed part of the body. Examples are the ancient tromba marina and the zither version of the Welsh *crwth*. A unique instrument is the American folk instrument Ukelin, which has strings in the middle to strum for chords and strings along both edges to play with a bow, thus demanding a dual classification as both a plucked and bowed zither, C55.21 and C55.22.
- **.23 Struck** (*santur*, Iran; *yang qin*, China; cimbalom, Hungary; hammer dulcimer, fortepiano, (but see C54 for the modern piano).

C56 Trough The strings are stretched over the lip of a trough, thus resembling a box without a top (*inanga,* Tutsi people, Rwanda).

C57 Harp Zither The body is a tube or stick, but the strings are thrown into a vertical plane by one or two notched bridges. The bridge aligns the strings in a plane perpendicular to the top surface, or sound table, as in a harp. In H-S, considerable confusion was evident in identifying these instruments. One was identified as a poly-idiochord musical bow or "harp-bow," H-S number 311.112, of the Fang people of Gabon. A name was not given, but this is clearly the *mvet*, more usually heterochord, and more straight than a bow shape, with one or more gourd resonators. The smaller *bogongo* of the Babinga people, Cenral African Republic, is a better example of the idiochord variety. Another instrument, specifically called "harp zither" in H-S, was described as a board zither with a notched bridge, number 314.22, from Borneo. These are united in K-Rev under harp zither.

C57.1 Idiochord harp zither cont. (*bogongo*, Babinga people, Central African Republic)
.2 Heterochord (*mvet*, Fang people, Gabon; [name], with two bridges, Dayak people, Kalimantan (island of Borneo).

C58 Frame There is no resonant enclosure, only an open frame with strings stretched across it. The typical instrument is the "Aeolian Harp" (but not a harp), in which the strings are set in motion by wind blowing across them.

C6 Lute A lute is a zither with a neck. The strings are in a plane parallel to the sound table but extend beyond it. This enables the player to stop the strings along the neck, changing their vibrating length, and thereby the pitch. As noted in the introduction, Galpin erred in making playing technique the prime binomial choice for chordophones, but when focusing on lutes in particular, this is often the first detail we want to know: is an instrument plucked or bowed? Dournon makes this the prime binomial choice for lutes, and so does K-Rev, with details of construction next. A question often arises about how to accommodate the familiar technique of plucking or striking the strings of a bowed instrument. The answer is that the instrument was designed to be bowed, and this determines its classification. Dournon creates a large number of subdivisions to itemize a variety of body shapes. This level of detail could be applied to K-Rev, but it is a project for the future.

C61 Plucked Lute The strings are plucked or strummed with a plectrum.

.1 One-piece The body and neck are carved from one piece of wood, normally membrane-covered (*sarod*, India; *rabab*, Afghanistan; *pipa*, China, with -w suffix)

.2 Multi-part

.21 Neck attached to body, normally wood-covered (Western **guitar**, lute; *baglama*, Turkey; *tambura* (no stopping of strings), India; *sitar* and *vina*, India). The Indian instruments might be described as borderline zithers, since their slender necks are actually hollow. It only points up the cousin-relationship of zithers and lutes.

.22 Neck pierces the body and forms the tailpiece: the **spike lute**, normally membrane-covered (*shamisen*, Japan; *sanxian*, China; *dotar*, India; banjo, USA)

.23 Neck inserted part way into body—the "half-spike lute," always membrane-covered (ngoni, Mali; *xalam*, Senegal; *keronna*, Sierra Leone; lutes of ancient Egypt)

C62 Bowed Lute The strings are set in motion by friction applied by a "bow," usually strands of horsehair stretched on a straight or curved stick. The term "fiddle," although associated with folk culture, has become a common generic term for the bowed lute.

.1 One-piece bowed lute The body and neck are carved from one piece of wood, normally membrane-covered (*gusle*, Croatia; *sarinda* and *sarangi*, India; *kemence*, Turkey, with -w suffix)

.2 Multi-part bowed lute

.21 Neck attached to body, normally wood-covered (violin; hurdy gurdy (with suffix -d for crank-driven disc in place of a bow); *bana*, C. India, with -mm suffix)

.22 Neck pierces the body: the **spike fiddle**, normally membrane-covered (*erhu*, China; *rebab*, Java; *rafon*, *goge*, West Africa; *masinqo*, Ethiophia; *ch'uniri*, Georgia; *haegum*, Korea, with -w suffix)

C7 Lyre or Yoke Lute: in place of the neck are two divergent arms (the yoke). The strings, lying parallel to the sound table, extend beyond the body to a crossbar at the extremity of the arms. As with the harp, the strings are played open. Lyres are typically membrane-covered. If the face is wood, add the suffix -w.

C7 Lyre cont.
C71 Bowl The body is bowl-shaped, as in a tortoise shell, metal pan, or carved wood (*krar*, Ethiopia; *nyatiti*, Kenya)
C72 Box The body is a box (ancient Greek *kithara*; one form of Welsh *crwth*; *bägänna*, Ethiopia)

A Aerophones Aerophones are instruments that are blown, or alternatively, moved through the air, to produce a sound. At root, they are the "hollow" instruments designated by the Sanskrit term *sushira* from the *Natyashastra.* In a way, it is fitting that they are the fourth great family in all the modern systems. Schaeffner lumped the first three together in his scheme and then dealt with the instruments of the air. Arriving at this fourth family, all other means of creating waves in the air have been accounted for; aerophones cover the rest. The classic H-S definition is "instruments in which air is the vibrator in the primary sense" (1961:24), but an oft-noted caveat to this has been added in the MIMO-revision, which is, to paraphrase: air is the primary vibrator only in edge instruments, because in reeds and lip-reeds, the vibration of those very agents initiates the tone.

Hornbostel and Sachs sought to extend the meaning of *sushira* by including instruments they called "free" aerophones – essentially instruments lacking an enclosed space to blow into. The terminology chosen was "free" (41) versus "wind instruments proper" (42). The distinction is maintained for K-Rev, but the terminology is changed. Dournon also chose a new terminology, and reversed the order, discussing what she called "enclosed" instruments first (41) and the "ambient" ones second (42). [As an aside, this is one of many reasons why Dournon's numbers should all be preceded by the letter D to distinguish them from their H-S counterparts.]

Agreeing with Dournon on the choice of "ambient" over "free," but seeking yet another term for the others, in K-Rev the choice is Ambient, A1, versus Blown, A2. In the latter are the familiar sub-families of flute, reed, and lip-reed, but with numerous reworkings, as will be detailed below. If the discussion of aerophones seems unusually detailed in comparison to the previous families, it is because there are many features of these instruments that have never been properly delineated for their classification.

A1 Ambient ("free") The instrument functions in the open air. H-S identifies three types: displacement, interruptive, and plosive, and the interruptives are further divided into idiophonic and non-idiophonic types. Certain free or ambient aerophones in H-S have become iconic: the sword blade, the whirring disc, the bull roarer, the siren. But seeking less cumbersome terminology, the whole ambient family has been rethought for K-Rev. Many have been moved elsewhere, resulting in a new list of three: (1) Slicing (two types), (2) Beating, and (3) the Whip. The last, grouped with the sword blade as a displacement instrument in H-S, produces a sound not by displacement, but by creating a miniature sonic boom and is thus afforded its own category A13. The principal idiophonic interruptive aerophones in H-S are the free reeds. But these are blown instruments, and thus in K-Rev join the other reeds, and will be discussed with them. The siren, although identified accurately enough in H-S as a non-idiophonic interruptive instrument, happens also to be a blown instrument, which means that in K-Rev it is afforded its own place there rather than among the ambient instruments. Finally, plosive aerophones are not actually ambient, since they make sound with enclosed air, but neither are they blown. In K-Rev they reside in their own category, A3.

A11 Slicing Ambient aerophone The object slices the air on edge. There are two actual instruments, the sword blade and the whirring disc, which may be categorized as follows:

- **.1 Momentary**. The sword blade, moved by hand through the air, displaces the air to either side for the moment it is in motion.
- **.2 Continuous**, or rotating. The whirring (or whizzing) disc, looking like a button, usually of wood, with a long loop of string running through two holes at the center, rotates like a wheel going forward, then reverse, when the strings are pulled. H-S classifies the whirring disc as an interruptive type (412.21), but this is incorrect. It slices the air much as a circular saw to make its whirring sound.

A12 Beating The sole representative of this type is an oblong plaque, usually of wood, attached to a string at one end and twirled overhead. It spins, or flips over and over on its long axis, an action that can be described as beating the air, causing pressure variations, and thus a roaring sound. This is the familiar bullroarer, a term "universally adopted in 1880 as the technical term in English" (Wachsmann, GDMI 1, 2014, 431), but there are many other appealing and typically onomatopoeic names for the instrument (*Schwirrholz*, Germany; *rhombe*, France; *firfironik*, Turkey (Picken 1975:370). Walker, in his *Flying Circus of Physics*, provides an additional observation: as the string is twirled, it twists until the blade stops spinning, then reverses. Air flowing past it also causes the string to "shed vortexes" (see the earlier introduction of this terminology under Shaken solid idiophones, Y43.1 above). The pressure variations caused by this action contribute both to the turning of the blade and to the sound (2007: §3.81, p. 177). Perhaps Galpin was not so far off in his 1937 system, assigning this instrument to the chordophones, since the string would appear to produce part of the sound.

A13 The whip Grouped in H-S with the sword blade as a displacement instrument, recent experiments by physicists have shown that the sound made by cracking a whip is in fact a miniature sonic boom, created as the tip reaches Mach 1. As such it is unique, and thus afforded a place of its own in K-Rev (see Walker 2007 §3.59, 170). Little did the ancient whip makers know that they were thousands of years ahead of their time.

A2 Blown The presence or absence of an air column in aerophones has been a stumbling block to understanding their nature. The term "blown" has been chosen for K-Rev to solve this problem. The members of this family, encompassing all the woodwinds and brass of the orchestra, all the free reeds, and many mechanical instruments such as the organ, have one thing in common: they are blown, whether by mouth, or mechanically. The sub-families in K-Rev match those in the H-S "wind instruments proper," except that in order to accommodate the "edge-tone instruments that are not flutes," in the words of Lawrence Picken in his monumental *Folk musical instruments of Turkey* (1975:376), and some other instruments, the blown sub-family in K-Rev begins with the heading "Open," into which the flutes and their relatives are subsumed.

A21 Open These are the instruments that truly fit the traditional definition in H-S: "The air itself is the vibrator in the primary sense" (1961:24). There are three types: edge, chamber-duct, and corrugated. To use Walker's terminology again, the action of "shedding vortexes" creates the sound in the first two, turbulence in the third.

A21.1 Edge instruments or flutes The K-Rev treatment of flutes differs from H-S in one important aspect. In H-S, flutes are divided first by the presence or absence of a duct. In the no-duct variety, end blown, side blown, and vessel flutes are clearly identified, but the oblique flute as a separate entity is missing, as is the presence or absence of a notch in end blown flutes. The MIMO-revision adds notch flutes (421.14), but the picture remains confusing. To address this, in K-Rev flutes are divided first by the features that are prime in our thinking about them, their shape and playing position, giving four types: vessel, vertical, oblique, and transverse. The presence or absence of a duct is moved to a sub-category, to be proliferated as necessary.

As with idiophones, if an instrument consists of a set of pipes rather than a single pipe, the #n suffix is used to identify it. If the pipes are in double ranks, as in some raft flutes ("panpipes"), this may be shown using the format #n+n. Two additional suffixes have potential use with flutes: -z for the presence of a sympathetic kazoo-like membrane (see M42), and -n to indicate nose flute.

A21.11 Vessel flute The instrument has a closed globular or tubular shape

.111 No duct The player directs an air stream across the embouchure hole at the top (*xun*, China; *kokwi,* Sierra Leone; *fetango*, Gambia). Note: The Tongan nose flute *fangufangu*, while looking like a transverse flute, is closed at both ends and is thus a no-duct vessel flute of tubular shape.

.112 Duct The air stream is directed by a mouthpiece to the edge that produces the sound (**ocarina**; Humanatone – toy nose flute in which the mouth is the vessel)

A21.12 Vertical flute The instrument is held or mounted in an upright position.

.121 No duct The player directs an air stream across the top of the pipe

.1 Straight cut

.11 Closed pipe (*hindewhu*, C. Africa; raft flutes ("panpipes") *siku, rondador*, Ecuador; *'au tahana* ensemble, 'Are'are people, Melanesia; *fozhobel*, Germany). The #n suffix or #n+n is used to specify the number of pipes and number of ranks. Further subdivisions may be established for the shape of the "raft," such as flat, curved, bundled, etc.

.12 Partly-closed pipe (MIMO has added this type, but without examples)

.13 Open pipe (raft flute, China; Bolivian *siku*, in which a rank of open pipes is paired to a rank of closed pipes, giving it a dual number: A21.121.11 and .13.

.2 Notched The front edge of the pipe is cut away to produce a knife edge

.21 Internal The inside of the bore is cut away (*xiao,* China)

.22 External The outside surface is cut away (*shakuhachi*, Japan; *kena*, Peru; hunter's flute, Ivory Coast)

.122 Duct The air stream is directed by a narrow passageway to a knife edge in the wall of the pipe.

.1 Internal The duct is created by a plug or block inside the pipe.

.11 No fingerholes (Native American eagle bone whistle; toy slide whistle; organ flue pipes). The organ itself will have the suffix -k for keyboard, plus the suffix #n for the number of pipes in each stop, or this detail may be handled by a statement of the range in octaves, in a verbal description.

.12 With fingerholes (recorder, *Blockflöte,* penny whistle)

.2 External The duct is outside the pipe

.21 No mouthpiece The player's lips are on the duct, created by a band around the pipe at a node at the top of the pipe (*suling*, Java & Bali)

.22 With mouthpiece: a mouthpiece directs the air to a block in the pipe which directs the air out of the pipe and back in, to the knife edge via the external duct. The duct is a narrow space under an object, usually in the shape of an animal or bird, attached to the pipe. (Plains Indian cedar flute, N. America)

A21.13 Oblique flute The instrument is held at an angle to the side of the mouth; the top rim is beveled.

.131 No fingerhole, or harmonic flute. The instrument is played by opening or closing the distal end to produce two sets of overtones, one from the closed pipe, one from the open pipe (*tilinca,* Bulgaria)

.132 With fingerholes (*ney,* Turkey, Egypt; *kaval*, Bulgaria)

A21.14 Transverse or side-blown flute The instrument is held parallel to the lips. Th player blows across an embouchure hole in the side of the pipe.

.141 No duct (the Western flute, fife; *bansuri*, India; other representatives the world over). MIMO identifies some varieties that are partly stopped, but they are not detailed here.

.142 Duct (*seljeflöte*, no-fingerhole harmonic flute, Norway)

A21.2 Chamber-duct instruments Air is directed through a pair of holes mounted at right angles to the airstream. Walker applied the term "hole tone" to this mechanism (2007:148), but in K-Rev the preferred term is chamber-duct. The latter organonym, coined by Susan Rawcliffe in 1992, focuses on the essential feature of these instruments: a chamber, usually flattened, with two holes opposite each other, functions as a duct. These are the instruments identified by Picken as "edge-tone instruments that are not flutes" (1975:376). He proposed the H-S number 420 for them to keep them close to flutes, and this has been retained in the MIMO revision, even though it is an anomaly, since H-S numbers do not have zeros. Picken identified two types, closed and open. Seeking terms that are more specific to these instruments, in K-Rev these types are identified as Simple (the closed type) and Vented (the open type). For the second, Rawcliffe prefers the term 'with exit hole.' The terms are equivalent and may be used interchangeably.

.21 Simple The instrument is nothing more than a closed chamber, usually somewhat flattened (picture the typical flying saucer) with holes exactly opposite each other in the top and bottom. Air blown through the holes in either direction makes the same sound. Picken identifies the widgeon whistle (a bird call made of metal) as an example (1975:377 & Pl. 29f). Other familiar examples are the squeaker in a rubber ducky toy, and the whistle in the lid of a teapot. The sound is much louder and more shrill than a typical edge instrument.

.22 Vented (with exit hole, multiple chamber) The primary chamber, as in type .21, is usually flattened, with holes opposite each other, but there is also a vent or exit hole in the side, and at least a second chamber or volume distal to the primary chamber.

.221 Mouth chamber – the sheepdog whistle. In this instrument, the required second chamber is not built into the instrument, but formed by the mouth when playing it. The instrument looks more like a taco than a flying saucer. It is usually made of a circular piece of metal folded in half and pierced through the two flat surfaces. To play, the instrument is placed in the mouth with the tongue pressed against the folded edge and the open edge (the exit hole, or vent) facing out between the lips. In this position, a second chamber is formed under the tongue. When blown, some air escapes through the vent, but crucially, some is directed to the mouth chamber under the tongue. José-Luis Franco was the first to study this mechanism, and described it as an airspring, or *muelle de aire* (1962:1 and 1971:20), because the air entering the second chamber meets resistance from the air already in the chamber, and essentially bounces back out the same hole it entered as it joins the air exiting the vent. This airspring effect changes the timbre of the sound. It can vary from breathy to shrill, but more reedy than a typical edge instrument. The player can control the pitch over an extended range by varying the size of the chamber under the tongue and by the velocity of blowing. In addition to the sheepdog whistle, this instrument was once a common toy made of various materials in many parts of the world (see Picken 1975:376 & Pl. 29e, Velázquez 2000, and Velázquez' website www.tlapitzalli.com).

.222 Globe chamber – the chamber-duct flute. One of the least-known instruments in the world, the chamber-duct flute was a specialty of Pre-Cortez Meso-American cultures. These instruments, invariably of clay, have a distinctive look: a globe projects from what otherwise might resemble a recorder or ocarina. This is the second chamber as described above, but built into the instrument. Air blown in enters the chamber-duct, which in these instruments is usually formed by a pair of perforated clay discs mounted parallel to each other in the wall of the second chamber. As in the sheepdog whistle, the air is subjected to the airspring effect as it bounces back out of the globe and joins the air exiting the vent in the side of the chamber-duct.

Many configurations are possible. The simplest is the dual chamber or dual volume just described. But in the more typical form, an elongated mouthpiece forms a chamber or volume of its own proximal to the chamber-duct, making a three-chambered or triple-volume instrument. The mouthpiece chamber is also subjected to the airspring effect from the globe. In addition, the typical instrument usually has a pipe or elongated chamber attached where the air exits the vent in the chamber-duct. This is a fourth chamber or volume, often with one or two fingerholes. Drawings by Franco and two photographs included in Marti (1968:156-61) are illustrative of this instrument. The principal studies after Franco's pioneering work are those by Rawcliffe (1992), and Velázquez (2002). See Mendelssohn 1972 for recordings of two actual Pre-Cortez instruments being played. Susan Rawcliffe makes and plays chamber-duct instruments of her own design today. See her other publications under References Cited, and her website, www.artawakening.com/soundworks.

A21.3 Corrugated pipe A corrugated or ribbed tube produces overtones through turbulence. This is a 20th-century invention, not included in H-S because it had not been invented even by the 1961 English translation. There are two types.

- **.31 Twirled** (the "Bloogle" toy). Twirling the flexible plastic tube draws air in at the proximal end and thrusts it out the distal end. With enough velocity, the corrugated surface causes turbulence (air pressure variation). As explained by Oberlin College professor of physics and acoustics Bruce Richards (and science advisor for K-Rev), when the turbulence matches the resonant frequency of the pipe, a sound is produced. With more velocity, the next partials are sounded. Partials 2-3-4 are readily obtained. The fundamental cannot be sounded because turbulence does not develop at the low speed required for it, and partial 5 and 6 (the third and fifth at the top of a bugle call) require very fast twirling. See also Walker (2007:§3.39, p.162).
- **.32 Blown** (the "Corrugahorn" toy, created by Frank Crawford (1989:14-16). Simply blowing into a small-diameter corrugated brass tube produces overtones depending on the velocity of the air. Crawford's instruments are typically bent in the shape of a trumpet, and some have a slide mechanism to change the fundamental.

A21.4 The siren, or pulsating blown aerophone. In H-S, the siren is classified as a non-idiophonic interruptive free aerophone, grouped with the whirring disc. But a crucial feature of the siren is that it is a mechanically blown instrument that produces a sound by interrupting a steady stream of air into pulses, and thus demands a category of its own. There are two types.

- **.41 Perforated disc** A jet of compressed air is blown at perforations in a rotating disc. This type was developed in the 19th century and is presumably the type Hornbostel and Sachs knew and included in their system. *Toy siren* (mounted on a ring, to be mouth-blown). Note: Walker coined the term "hole tone" to describe the mechanism (§3.3, p. 148), and describes the teapot whistle as another example of it. But as noted above, in K-Rev these are kept separate, with the teapot whistle designated more accurately as a simple chamber-duct instrument, A21.21.
- **.42 Centrifugal fan** This is the more typical fire engine siren of today. A squirrel-cage type fan with a number of slots in the wall is spun by an electric motor (or cranked by hand). Air is drawn into the open front of the drum-shaped fan, which propels the air radially outward through matching slots in the fan housing (see www.howthingswork.virginia.edu). The air propelled by the fan is interrupted by the solid spaces between the slots, and the rapid pressure change causes the sound. The pitch is determined by the speed of rotation.

A22 Reed. A thin blade (or more than one) is mounted on the instrument or cut from the wall of the tube (termed idioglot), in such a way that one end is "clamped" or fixed in place, while the other vibrates when air is blown past it. In K-Rev, all reeds are here, accommodated in newly-labeled categories. The numbers get longer, but in the end, all the "free" reeds ("idiophonic interruptive" in H-S), the ribbon reed, and a large number of confusing sub-varieties of "beating" reeds are newly explained. The terms "free" and "beating" are in quotes because a new terminology should be adopted. To the physicist, a preferable pair of terms for these is "hard" and "soft," to be explained below.

A22.1 Hard-tuned (free) reed A reed is made by cutting a tongue from a sheet of brass (alternatively, cane or plastic), leaving the base of the tongue intact ("clamped"). The vibrating end does not touch the frame around it – hence the designation "free." The reed is tuned during manufacture to produce a single pitch. This is the reason for the "hard" designation – the reed is hard-tuned, so to speak, designed to produce only that pitch (see Hall 2002:264). Free reed instruments typically consist of sets of reeds mounted in resonating tubes or chambers. Two exceptions are the mouth-blown one-directional reed (A22.111), and the free reed with fingerholes (A22.212.3). Note: If the human voice were to be assigned a classification, it would fit here. The vocal folds are made of soft tissue and, viewed in a laryngoscope, resemble the opening of a double reed such as the oboe. But Bruce Richards notes that they function as a hard reed, tuned from moment to moment by muscle tension to produce each note desired (personal communication, 2010).

.11 Mouth-blown

.111 One-directional. A single reed is cut from a strip of bamboo (thus idioglot, which may be indicated with the suffix -i) and blown in one direction to produce one note (*ngo*, or "frog," Bali). It is typically played in sets by several players. A mechanical version of this also exists (see A22.13 below).

.112 Bi-directional – the mouth organ A set of hard-tuned reeds, designed to produce sound on both exhale and inhale. There are two types, single- or double-action. The latter is the older, but will be described second, since they have been numbered in K-Rev to match their names: (1-single, 2-double).

.1 Single action – the harmonica The term single action means that each note is keyed to the direction of the air. The reeds are mounted in opposed pairs in the walls of short square tubes. One of each pair is mounted with the vibrating end facing away from the player and sounds when blown. The other is mounted with the vibrating end facing the player; this one sounds on inhale. The instrument was invented in Germany, inspired by the double-action instrument to be described below, and is thus designed to produce chords by engaging several tubes at once. Pitch bending (as in the typical "blues harp" style) affords other notes, accomplished by cupping the hand.

.2 Double action – the Chinese sheng On a double-action mouth organ, the direction of the air does not matter. Each reed produces its note whether the player is blowing or inhaling – hence the term double-action. This is accomplished by creating a pressure environment for the reeds. Each reed is mounted in its own resonating tube with a fingerhole, and the tubes are inserted in a wind chamber made of a gourd, wood, or metal. The player blows or inhales through a mouthpiece in the chamber. Regardless of the direction of the air, if a fingerhole is closed, the reed will sound its note. Picken explains this phenomenon: air is blowing past the reeds all the time, but only when a fingerhole is closed does the impedance or resistance in the pipe match the elastic force of the tongue as it is displaced by the air, allowing it to sound (1984:149).

A parallel explanation is offered by Bruce Richards, comparing the fingerhole on Asian free reeds to the register key on a woodwind. On a Western instrument such as the oboe or clarinet, the fundamental register is produced with the register key closed. If the register key is opened, the pressure antinode for the fundamental is suppressed, and in its place the note in the next register sounds, supported by other resonant frequencies in the pipe. But on a free reed, "hard-tuned" to produce just one note with the fingerhole closed, when this "register key" is opened, the tone stops, because the other resonant frequencies in the pipe do not match the single frequency of the reed (*sheng*, China; *khaen*, Laos and Thailand; *sompoton*, Malaysia).

A22.12 Bellows-blown hard-tuned (free) reed – the accordion Air is pumped into a common chamber in which the reeds are mounted. Buttons or keys admit air to individual reeds or to groups of reeds for chords.

.121 One-directional Air is pumped in one direction only (early Western reed organs and their successors, the harmonium and *sruti box* of India)

.122 Bi-directional Air is drawn in and pushed out, replicating the effect of the mouth organ.

.1 Single action The singe-action or button accordion is a bellows-blown version of the harmonica. The reeds are mounted in pairs, each producing a different note, one on the push, one on the draw. Buttons admit air to a reed chamber, or to several at once for chords. The notes sounded will depend on whether the air is being pushed or drawn. Examples are the 1-, 2-, and 3-row button accordions of Louisiana Cajun culture, Dominican Republic *merengue* bands, Irish pub and Mexican *conjunto* bands; the Argentine *bandoneón*; the "Anglo" as opposed to "English" concertina.

.2 Double action The piano accordion is a double action instrument. The right hand keys admit air to reed chambers; the left hand buttons admit air to many chambers at once for chords. As in the single-action instrument, the reeds are mounted in pairs, but the reeds in a pair both produce the same note, so it does not matter which way the bellows are moving (English concertina; standard piano-key accordion).

A22.13 Steam-blown One German-designed version of whistling teapot has, instead of the familiar chamber-duct in the lid, two free reeds that sound when the steam velocity is sufficient. The sound resembles a steam locomotive whistle.

A22.2 Soft-tuned (beating) reed The term "beating" distinguishes these from the free reeds, but it is not completely accurate, as noted above. The reed is mounted in such a way that it can beat against the mouthpiece or another reed (the double reed), but in reality it may not completely close the orifice. The "soft" terminology (meaning malleable or compliant) portrays more accurately how these reeds function: blowing on the reed generates air waves in the pipe, but the vibration rate (i.e., the pitch) is determined primarily by the length and shape of the air column, not the nature of the reed.

In Hornbostel-Sachs, and in common parlance, beating reeds fall into two camps: the single reeds (such as the clarinet) and the double reeds (such as the oboe). But, as Galpin so astutely noted in 1937, Hornbostel and Sachs erred in adopting this criterion for their system, because for reed instruments, it is the shape of the bore – conical or cylindrical – that has greater bearing on tone color and technique (especially fingerings, as any clarinet/sax player can explain). To rectify this, in K-Rev the prime binomial for reeds, save one detail, is bore shape.

The detail to be included here is a feature overlooked by Hornbostel and Sachs: is the soft-tuned reed normally open or normally closed? Most of the familiar instruments are normally open, forced to close and then open again when blown. But normally-closed reeds exist. Galpin was one of the first (if not the first) to identify them for organology. In 1903 he described two instruments that represent two types of normally-closed reeds, to be detailed below. To accommodate this variety of soft-tuned reeds, the choice of normally open versus normally closed must be inserted here.

A22.21 Normally open (Soft-tuned (beating) reed cont.) The reed is open, forced to close when blown. All of the familiar orchestral reeds are here, listed in order of bore shape. In addition, in K-Rev a third category called "mouthpiece only" (see A22.213 below) has been created to accommodate a large number of reeds that, even in the MIMO-revised H-S, are plagued by confusing names.

.211 Conical bore When a reed (single or double) is fitted to a conical pipe, even though it may not actually close the pipe, it causes the pipe to function as a closed pipe. The crucial feature here is that air vibrating in a conical pipe creates spherical waves, which include all partials of the overtone series. Thus, the first overblown note is the second partial, or octave.

.1 Single reed (the **saxophone**; *tarogoato*, Hungary; oboe with jazz player's single-reed;). The reed and trumpet pipes in a pipe organ are also single reeds. They are tuned to a specific pitch, and thus resemble free reeds, but physically they are beating reeds, fixed to a mouthpiece-like tube called a shallot, and usually coupled with conical resonators. The "single-note motor horn" noted as an example in MIMO-revised H-S (412.121) is of the same type, i.e., the bulb-activated horn on buses and rickshaws in India, with a bugle-like conical brass resonator. (In the H-S original, this was mistakenly identified as a free reed.)

.2 Double reed

.21 One-piece flattened tube A tubular material (*pala* grass, for example) is flattened but not split; no further working of the reed is necessary (*shenai* or *sahnai*, N. India; *nagaswaram*, S. India).

.22 Two-piece cane Two separate pieces of cane (*Arunda donax* or similar) are shaved thin and bound together around the staple (a small tube at the top of the instrument) to form the reed (**oboe**, bassoon, Scottish bagpipe chanter). Note: Bagpipes are identified in GDMI as "composite reedpipes." To classify an instrument that has a combination of conical/cylindrical pipes or single/double reeds will require a dual number to show the separate parts.

.23 Quadruple reed Both sides of the double reed are made of a folded palm leaf bound to the staple with no further working (*bee* or *pi-nai*, Thailand; *zurna*, Turkey).

.212 Cylindrical bore As with the conical bore, a soft-tuned reed fitted to a cylindrical pipe functions as a closed end to the pipe. But a cylindrical pipe creates planar (flat-surfaced) waves, and these include only the odd-numbered partials. The fundamental pitch of a cylindrical pipe is an octave lower than a conical pipe of the same length, and the first overblown note (if possible at all) is the third partial (a 12th above the fundamental) rather than the second partial (the octave). In theory, such a pipe lacks not only the second partial, but all other even-numbered partials. In practice, this is not always the case, but the octave-lower pitch and overblowing to the third partial are hallmarks of the cylindrical bore.

.1 Single reed (the **clarinet**; *arghul*, Egypt; *launeddas*, Sardinia; most bagpipe drones, and in some, the chanter as well; *pungi* (the snake-charmer's instrument), India).

Suffixes may be added for instruments with an air reservoir: -p for bagpipe, -g for the globe (gourd) of the pungi. These instruments are often double-piped (two instruments side by side), which may be indicated with the #n suffix. With the exception of the clarinet, all are idioglot. See note above (A22.211.22) about dual numbers for bagpipes.

A22.212 Cylindrical bore Normally open reed cont.

.2 Double reed (*piri,* Korea; *hichiriki,* Japan; *mey*, Turkey; small-pipe chanter, Scotland). See Flora 1974 for an acoustical study of the first two of these.

.3 Free reed In this instrument, a free reed is mounted in the wall of a cane pipe. In most applications, the free reed is a hard reed, producing a pre-tuned note only. But in this instrument, unique to Asia, the free reed, when overblown, functions more like a clarinet reed, its pitch coupled to the length of the pipe as determined by fingerholes to produce different pitches. It does not sound on inhale. (*pi jum*, Thailand; *pey pork*, Cambodia; *bawu,* China).

A22.213 No-bore, or Mouthpiece-only reed This category has been created to accommodate a number of small reed instruments that are in fact nothing but a mouthpiece. Most are children's toys of the sort that have virtually disappeared today, along with many other folk and rural customs, but they must nevertheless be classified. In H-S, because they were not coupled to an air column, they were listed among the free aerophones. In MIMO-revised H-S, they are still there, with new names, but still confusing. Montagu has observed that all of them have a counterpart in a larger instrument with fingerholes (2007:213). Picking up on this, and to simplify the picture, in K-Rev they are placed here.

.1 Single reed In H-S 1961 these were called "percussion" reeds. In the MIMO revision they are called (unfortunately) "beating." The instruments make a single sound (Northwest Coast American Indian instruments, street toy with paper horn, India).

.2 Double (or multiple) reed In the 1961 H-S, these were called "concussion" reeds. Fortunately in the MMO revision they are called "paired." The classic example given for this type of reed has always been a "split grass blade," in which two (or more) reeds are created in the normally-open position. But if one reads Lawrence Picken's *Folk musical instruments of Turkey* closely, it is clear that this is a misnomer: it is a split grass stem that is used to make this instrument, not a blade (see "split corn stalk whistle" in Picken (1975:349).

A22.22 Normally closed reed For these instruments, the conical/cylindrical distinction is not as critical as for the normally-open reeds, nor do the terms single or double reed apply in a logical way. The subdivisions here focus instead on other details of their construction. There are two types, split or membrane. It will be noted that each of these also includes the newly-created category of mouthpiece only, seen above for the normally-open reeds.

.221 Split A hollow stem (rice, for example) is split or cut, or pieces of wood are fashioned in a similar manner, so that the edges of the cut remain closed until forced open by the breath, typically blown from the end opposite the reed. Galpin first described this mechanism and called it a "retreating reed" (1903:127). Military imagery may be invoked to understand what he meant: when troops in formation are commanded to retreat, they break ranks, i.e., split apart, which is what these reeds do.

.1 Mouthpiece only (Tlingit and Bella Bella American Indian whistles (Galpin 1903:127-28); child's hemlock whistle, Turkey (Picken 1975:347-48).

.2 With fingerholes (the Sami *fadno*, Finland (Emsheimer 1947). Another term has emerged for this variety and is included in MIMO-revised H-S: dilating. Unfortunately this refers to exactly the same mechanism as the retreating reed, and is therefore confusing and redundant. Both terms are best dropped in favor of "normally-closed split reed."

A22.222 Membrano-reed (Normally closed reed cont.) This normally-closed soft-tuned (beating) reed was not included in the original 1914 Hornbostel-Sachs, even though Galpin had described it in the 1903 paper noted above, as the mechanism in a deer call of the Ainu of Japan (1903:129). It has been tacked on to the very end of aerophones as "membranopipe" (424) in the MIMO-revision (there was no other place for it), but in K-Rev it has its proper home here, as a normally-closed reed. The mechanism is as follows: a membrane closes the top of a double-walled cylinder that is also closed at the bottom. Air blown in from a hole in the outer wall can escape only by forcing the membrane open, which then functions as a soft-tuned reed.

.1 Mouthpiece only (*ippaki-ni*, Ainu of Japan; *Mega-Blast* and *Sonic-Blast* toys (Knight, 2014)

.2 With fingerholes (toys made in Indonesia (Hopkin, 1991)

A22.3 Ribbon reed In H-S this was a third type of free aerophone along with the two discussed in A22.213 above. But it is unique and deserves its own category. A thin material, such as a blade of grass, held taut between thumb knuckles in front of the mouth; varying the tension alters the pitch. A ribbon reed can also be mounted in a frame. In MIMO it is described as an instrument whose acoustic properties have not yet been studied. But awaiting the research by physicists, we may rely for the time being on Picken (1975:365), who gives a careful description of his understanding of the mechanism, based on turbulence (Tsimshian Indians (Galpin 1903:130); Turkey (Picken 1975:368 and Pl 29).

A23 Lip reed The brass instruments of the orchestra, horns, trumpets, and the rest, fall into this category. For the MIMO revision of H-S the consortium has decided to use a term coined by Anthony Baines, *labrosone*, or lip-sounded, since most of the familiar Western terms for these instruments are too restrictive, leaving out shapes or materials that belong in the group. I prefer to stick with the more familiar "Lip-reed."

The player blows through pursed lips, which function as a "normally closed" reed. Using only lip tension, the overtones that define the tone color by their relative strengths may be isolated to produce a series of notes without altering the length of the pipe, as in typical bugle calls. As in reeds, acoustically the lips form a closed end to the pipe. But unlike reeds, the shape of the bore (cylindrical vs. conical) is less critical in determining which overtones (harmonics, partials) are available. This is because even predominantly cylindrical instruments such as the trumpet and trombone have a carefully-shaped mouthpiece and bell, and these features cause the bore to function as if conical, producing spherical waves with all partials represented. Some instruments are designed to capitalize more on the higher partials, while others work in a smaller range. The French horn, for example, utilizes partials 2 to 16 on the F horn (an octave to four octaves above the fundamental) and can also use the fundamental of the B-flat horn. The trombone, on the other hand, is rarely called upon to play its fundamental, or pedal tone; the orchestral repertoire demands only partials 2 to 6, although jazz players might reach partial 8. (For a thorough explanation of the physics of these phenomena, see Benade and Campbell, Acoustics §IV, in *The New Grove Dictionary of Music*.)

In the broader world picture, however, there are many lip-reeds that cannot be made to produce more than one or two partials. The factors that limit overtone production are a large bore size in relation to the length, and the lack of a cup or funnel-shaped mouthpiece. These factors are not spelled out in H-S, where the first subdivision of lip-reeds is between natural and chromatic trumpets. But as Montagu has noted, this invites confusion, since to most people the term "natural" would refer to instruments made of a shell or horn, and yet in H-S the category also includes "tubular" instruments, calling them trumpets if straight, horns if curved.

To circumvent these problems entirely, in K-Rev the primary subdivision is based on the capability for overtone production, producing the following two families: (1) instruments with a narrow compass, because their physical features limit overtone production, and (2) instruments with a wide compass because their physical features promote overtone production. As in Hornbostel-Sachs, where the conical/cylindrical bore comes into play only in limited instances, in K-Rev the distinction enters only when necessary to distinguish otherwise nearly identical instruments, such as the trumpet and cornet.

A23.1 Narrow compass These instruments are confined to one or two notes (i.e. the first and second or second and third partials) because they have no cupped mouthpiece, or the bore is large for its length.

- **.11 Fixed length**
- **.111 Side blown**: animal horn or elephant tusk trumpets without end hole (*kwatha*, kudu horn trumpet, Chwana people, South Africa – see Kirby; *hakum*, lost-wax brass horn of the Muria, Central India)
- **.112 End blown** (*shankh* [conch], India; *dijeridu*, Australia; *vaccine*, Haiti; *rag-dung*, Tibet; *kakaki,* Nigeria). The last two are long and narrow, but lack the cupped mouthpiece. The *vuvuzela*, made famous at World Cup Soccer 2010 fits here.
- **.12 Variable length** (narrow compass lip reed)
- **.121 Side blown**: animal horn or tusk trumpets with a hole in the tip (*hakum* cow horn of the Muria, Central India)
- **.122 End blown** (*algoza*, bamboo pipe with fingerholes, Ahir people, Central India)

A23.2 Wide compass In these instruments, the combination of a cupped or funnel mouthpiece and comparatively narrow bore relative to length enables the player to isolate (produce) partials beyond #4 (the second octave), in some instruments up to the 12th or even the 16th partial.

- **.21 Fixed length** These instruments are limited to one set of partials (Baroque trumpet, bugle, alphorn)
- **.22 Variable length**
- **.221 Fingerhole** (Western cornett, serpent)
- **.222 Slide** A slide mechanism lengthens the bore, producing a new fundamental and its overtones (trombone, Medieval European trumpet).
- **.223 Valve**. The length of the bore is increased by valves that admit air to additional lengths of tubing, each providing a new fundamental and its overtones. (trumpet, cornet, French horn, tuba)

A3 Plosive aerophone (German: *explosiv-aerophone*) One of the free aerophones in H-S, this type requires its own category. The air is contained, therefore not ambient, but neither is it blown. MIMO-revised identifies two types, as does K-Rev, but with different terms.
A31 Closed Air is rapidly compressed in a small space, which then explodes. The simplest form is an ephemeral toy: a thin leaf or flower petal is poised on an "O" formed by thumb and finger, then slapped to cause a "pop" as the petal explodes (see Picken 1975:372). An actual instrument is the pop gun, in which a cork in the end of a tube bursts out when the piston is pushed. The 100-year-old explanation in H-S (413 Plosive) is "The air is made to vibrate by a single density stimulus condensation shock." I prefer the explanation of the physics of this sound given by my colleague Bruce Richards: "The sudden release of high pressure air initiates a compression pulse wave that reaches our ear as the popping sound" (Pers. Comm. 2015).
A32 Open The open end of a vessel (closed or open at the other end) is slapped or at least partly closed by another object, setting up a vibration of air in the vessel at its resonant frequency (*shantu*, Nigeria; *boing pipe* with floating top, invented by Madin (1996:9).

Suffix Glossary

Suffixes are used to include supplementary information about an instrument that does not change its classification. A K-Rev number without a suffix where one might be applicable is not wrong, it is simply less complete than if the information were known. For example, if the playing technique for a given drum is not known, no suffix delineating this detail would be added to the number. The drum would still be correctly identified by its shape and number of heads.

#n Supply a number for n to indicate the number of sounding elements in certain instruments, such as xylophones and panpipes. The format #n+n may be used to identify ranks of pipes. This suffix may also be used to identify the number of strings on a chordophone.
-1 played with one stick (-1 to -5 and -a, -b, -c are applicable to membranophones)
-2 played with two sticks
-3 played with one hand
-4 played with two hands
-5 played with stick and hand
-a thin head
-b medium head
-c thick head
-d crank-driven, as in the hurdy-gurdy
-e electrically-powered sound modification, as in a vibraphone
-f frets on a stringed instrument
-g globe reservoir (as in the Indian *pungi)*
-h handle drum
-i idioglot (reed aerophone) or idiochord (chordophone)
-k keyboard
-m mechanical activation
-mm membrane sound table (as on Turkish *kanun*) where the material is normally wood
-n nose flute (played with nasal breath)
-p bag reservoir (as in a bagpipe)
-s sympathetic or co-vibrator, idiophonic in nature, as in bottle caps on an *mbira*
-w wood sound table (Chinese *nan hu*, Korean *haegum*), instead of typical membrane
-x snare (of any material) crossing the surface of a drum head
-z sympathetic membrane (kazoo-like), as on some Asian flutes and African xylophones

Membranophone suffixes adopted from Hornbostel-Sachs

(The wording has been streamlined and the term "bracing" replaced with "lacing")

-6 Membrane glued to drum
-7 Membrane nailed to drum
-8 Membrane laced to drum
-81 Cord-lacing: The cords or ribbons are stretched from head to head or arranged in the form of a net, without the devices listed in -82 to -86.
-811 No additional tensioning
-812 Tension ligature: Cords lacing the two heads are tied around the middle by another cord to increase the tension (Sri Lanka, Dominican Republic)
-813 Tension loops: The cords are laced in a zigzag; every pair of strings is caught together with a small ring or loop (India, Nepal)
-814 Wedges: Wedges are inserted between the lacing and the body to add tension (India, Indonesia, Africa)

-82 Cord-and-hide: Cords attached at the bottom to a non-sonorous piece of hide (Africa)
-83 Cord-and-board: Cords attached at the bottom to an auxiliary board (Sumatra)
-84 Cord-and-flange: Cords attached to a bottom flange carved from the wood (Africa)
-85 Cord-and-hoop: Cords attached at the bottom to a hoop of different material (India)
-86 Cord-and-pegs: Cords tied under pegs inserted in the drum shell (Africa)

Note: -82 to -86 may also be further subdivided as -81 above

-9 Membrane lapped on by ring of cord (Africa)
-92 Membrane lapped on by a hoop
-921 No tightening mechanism
-922 Tightening mechanism
-9221 Wing-nut (early timpani)
-9222 Pedal (Pedal timpani)

An example of the full application of suffixes for a membranophone in K-Rev:

The number M11.15 alone correctly identifies the West African goblet drum *djembe*. With all applicable suffixes the number would be M11.15 -85 -s -b -4.
That is: cord-and-hoop lacing (-85), sympathetic vibrators (-s), a medium-thick head (-b), and played with both hands (-4).

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