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Instruments, classification of.

1. Introduction: the classification system of Hornbostel and Sachs.

'Musical instrument' is a self-explanatory term for an observer in his own society; it is less easy to apply on a worldwide scale because the notion of music itself in such a wide context escapes definition. Hornbostel (1933, p.129) advised that 'for purposes of research everything must count as a musical instrument with which sound can be produced intentionally', and wrote of sound-producing instruments, or, for short, sound instruments. The German word 'Instrumentenkunde' and its English equivalent 'organology' avoid the issue by taking the reference to sound or music for granted. Hood (1971, p.124) distinguished between organology and organography, intending the distinction to separate description plain and simple from the body of knowledge that bears on problems of taxonomy and on the principles that at one time or another have served as bases for systems of classification. Both have in common a concern for structural detail.

Scope of the study of instruments as objects and as…

The flow chart (fig.1), mapping currents of ideas about musical instruments, places construction (material, design) at the centre, as the common ground and link between organography and organology. The three rectangles to the right refer to intrinsically musical aspects, those to the left to contextual ones. Lateral arrows lead to the centre of the diagram, while curved lines bypassing the centre indicate that a classification might treat details of construction as secondary in importance. For the collector of musical instruments concerned primarily with the objects themselves, or for the performer in his own native music, some of the headings in the diagram must seem far-fetched, yet any one of them could serve as a major criterion for classification in any of the 5000 languages of the world. Some classifications may be narrowly local, utilitarian or ethnic. Others are speculative in that they are derived from a cosmology and meet the challenge of universal applicability because the cosmology is itself implicitly universal.

The first classification of musical instruments suitable for worldwide use was devised by Victor-Charles Mahillon, curator of the instrument museum of the Brussels Conservatory, for his catalogue of the collection. Mahillon's catalogue, which began to appear in 1880, became the basis of several later systems, the most notable of which was that of E.M. von Hornbostel and Curt Sachs in their *Systematik der Musikinstrumente: ein Versuch*, published in 1914. This system eclipsed its predecessor and achieved a pre-eminence which it never lost, despite subsequent challenges, adaptations and developments. Hornbostel and Sachs were as concerned to establish an open-ended discussion ('ein Versuch') of the problems inherent in classifying musical instruments as they were to show how their own ideas could best be translated into practice. Their use of the Dewey decimal system heralded the important role of non-verbal symbols in years to come. The introduction to the classification, in which they discussed general principles and anticipated the criticisms that their practical system might invite, is printed in its English translation as an appendix to this article.

The classification proper, which follows on the introduction, includes definitions where terms are not self-explanatory (for full lists, *see* AEROPHONE, CHORDOPHONE, IDIOPHONE, MEMBRANOPHONE).

The main headings up to the third digit of the numerical code give a comprehensive view of the classification, as follows:

1 Idiophones (80 entries)

11 struck idiophones

111 idiophones struck directly

112 idiophones struck indirectly

12 plucked idiophones

121 in form of a frame

122 in comb-form

13 friction idiophones

131 friction sticks

132 friction plaques

133 friction vessels

14 blown idiophones

141 blown sticks

142 blown plaques

2 Membranophones (43 entries plus 20 suffix entries)

21 struck drums

211 drums struck directly

212 rattle drums

22 plucked drums

23 friction drums

231 friction drums with stick

232 friction drums with cord

233 hand friction drums

24 singing membranes (kazoos)

241 free kazoos

242 tube- or vessel-kazoos

3 Chordophones (79 entries)

31 simple chordophones or zithers

311 bar zithers

312 tube zithers

313 raft zithers

314 board zithers

315 trough zithers

316 frame zithers

32 composite chordophones

321 lutes

322 harps

323 harp lutes

4 Aerophones (122 entries)

41 free aerophones

411 displacement free aerophones

412 interruptive free aerophones

413 plosive aerophones

42 wind instruments proper

421 edge instruments or flutes

422 reed pipes

423 trumpets

What must have seemed most curious to contemporaries of Hornbostel and Sachs in the Europe of 1914 was the size and scope of the class of idiophones. Although some of them were familiar from traditional music, other music hardly made use of them. Yet they were about to invade and conquer a large section of Western instrumentation, and by the 1970s the Hornbostel and Sachs classification appeared well balanced with respect to Western music of all kinds. The traditional threefold division into string, wind and percussion had found a rival.

Klaus Wachsmann/Margaret J. Kartomi

2. Precursors.

Recent research has drawn attention to the need to view the Hornbostel and Sachs system, and others, in a historical perspective, including schemes in the ancient or classical societies of Greece, the Arab world, China, South Asia and elsewhere. For example, the traditional European threefold division into string, wind and percussion instruments derived from and was also at times an alternative to the twofold classification evident in ancient Greek and early Christian thought. In Hellenic Greece, instruments were classified in two groups, the animate (‘the human vocal’) and the inanimate, with a further classification of inanimate instruments into string and wind, ignoring percussion. In later Hellenistic Greece the rhetorician Pollux (late 2nd century CE) distinguished a category of percussion instruments, which included plucked or beaten strings, and one of wind instruments, while the first three-category classification of wind, string and percussion was presented by Porphyry (242/3–*c*305 CE). The predominant structure of classification schemes from late Roman through the medieval and Renaissance periods into the 20th century was the three-category model presented by Boethius in the order of string, wind and percussion, though the two-category model of Pollux also showed some persistence. The vocal instrument continued to reign supreme until modern times, but the reputation of inanimate instruments, especially strings and winds, grew steadily.

In the Arab world, orally transmitted taxonomy has survived which distinguished instruments according to myths of their origin and included wind, string and percussion instruments, but the theorist Al-Fārābī excluded percussion from his broad-ranging but basically twofold classification of string and wind instruments. Twofold and threefold Greek and Roman schemes persisted in European classifications for at least 1200 years though based on a different rationale. The

fourfold Hornbostel and Sachs scheme somewhat resembles an ancient Indian scheme developed in the *Nāṭyaśāstra* treatise (2nd century BCE–6th century CE) which includes stretched strings, 'covered' drums, 'hollow' winds and 'solid' idiophones.

Margaret J. Kartomi

3. Extensions.

The Hornbostel and Sachs scheme has been extended to encompass new types of instrument and changing views of the term 'instrument'. Galpin took note of the latest developments, adding a fifth 'genus' called 'electrophonic instruments' (1937, pp.29–30). Sachs, who called this group 'electrophones' (*SachsH*, pp.447–9, 467), divided it into three subcategories: (1) instruments with electronic action; (2) 'electro-mechanical' instruments (in which sounds produced in the usual way are transformed into electric vibrations by amplification through an electronic device); and (3) 'radioelectric', based on oscillating electric circuits (see Kartomi, 172–3). Hood (1971, p.144) named this category 'electronophones' whereas Sakurai (p.40) argued that 'electrophones' should not be regarded as one single group because they have heterogeneous primary resonators. The category became accepted in its broad outlines though it, and its terminology, have been loosely used. Logically it should include only instruments that actually produce sounds by electrical means (e.g. organs with electric action) as well as radioelectric instruments (such as synthesizers) that are characterized by their electric source of sound. Articles by Moorer (1977) and Risset and Wessel (1982) clarified the distinction between instruments that produce sounds electronically and those that simply process natural sounds. Bakan, Bryant and Li (1990) called their fifth category electronophones and divided it into synthesizers and samplers; instruments with electronic action were placed elsewhere. (*See* ELECTROPHONE.)

In the late 20th century the human voice was often considered to be a musical instrument and was used as such in some new compositions. The idea is very old (see §2 above); the Indian writer Nārada (between the 10th and 12th centuries) also included the singing voice, along with handclapping, among his five categories of instrument (*Saṅgīta-makarāṇḍa*). In 1980 Dale Olsen introduced the term 'corpophones' for instruments that are part of the human body.

Margaret J. Kartomi

4. Other 20th-century approaches.

Critics of the Hornbostel and Sachs system point to the calculated lack of a uniform principle for determining the hierarchies within the different groups. Schaeffner's classification is invulnerable in this respect; indeed, he presented a system that was logically perfect and coherent. Schaeffner distinguished two main classes: vibrating solid substances and vibrating air. The class of solid substances is divided into three groups: non-tensile, flexible and tensile. At first glance it must seem odd that strings and membranes should be lumped together in the same group because of the susceptibility to tension that they have in common, but it will seem convincing to anyone who has seen the fingers of the left hand of an Iranian *tombak* player 'fingering' the drumhead: the juxtaposition of string and drum reflects not simply the cold logic of the system, but musical sense as well. There is indeed a significant link between classification and music. However, Schaeffner's system is rarely used.

Dräger matched the scope envisaged in the flow chart above (fig.1). He argued that he could not identify an instrument satisfactorily unless he took into account the musical and also physiological functions that it was to serve. This led him to consider not only aspects of the object as they present themselves to the eye but also the many linkages that tie a musical instrument to the player's person. In addition, the description of the musical instrument was to include its acoustic potential. Dräger's ideas were logical extensions of the Hornbostel and Sachs system (Dräger was a pupil of Sachs). His *Prinzip* sketches the outlines of an ideal organology that

would require for its application a wealth of data – a thorough understanding of musical practice, collectively, and the person of the player, individually – that are not available on a worldwide scale.

Hood, too, sought to go beyond organography and establish a genuine organology that would attend to ‘particular techniques of performance, musical function, decoration (as distinct from construction) and a variety of socio-cultural considerations’ (p.124). Towards this end he designed a ‘symbolic taxonomy, inspired by the symbolic language of Labanotation [a method of dance and movement notation]’. His ‘organograms’, have occasionally been severely criticized (for a complex example, with Hood’s reading of it, see fig.2 [not available online]); however, they do seem to appeal to a generation of scholars familiar with symbolic languages and diagrams and less committed than their elders to verbalization.

A significant trend in organology since the 1960s has been towards emancipation from the musical instrument as an object, for the sake of a deeper understanding of the musical instrument as aspect (see Reinecke, p.177). Reinecke gave an example of what such a change of approach might mean, and the kind of classification that might emerge from it, by showing how four classes of instruments – trumpet instruments, flute instruments, bells and gongs (‘ringing metal’), and string instruments – could correlate with the following set of four emotional stereotypes: first, the aspect of awe, of catastrophe, that describes awareness (conscious or otherwise) of the limited power of humankind, of one’s being subjected to destiny, in short, the opposite to the possession of ‘superior force’; second, the aspect of the category ‘life’, of fertility and resurrection, in short, the opposite of death; third, the aspect of authority, as (acknowledged) power to which one must bow; and fourth, the aspect of one’s realization of the existence of order as a force, of harmony that corresponds to the emotional aspect of wisdom, insight and foresight. Such correlations were foreshadowed in the work of Sachs (1929) and Schaeffner (1936). Reinecke’s approach is in line with the tendency in the social sciences to formulate questions and seek explanations in the function of a phenomenon rather than in its structure. The mechanical and acoustic structure of the musical instrument thus becomes part of a parcel of information embracing a whole cluster of relationships. In fig.1 this requirement is reflected in the fact that the lateral arrows converge on the object instead of emanating from it.

The practical completion of Dräger’s multi-faceted classification scheme awaited the development of the computer, which made possible the extension of the boundaries to encompass any criteria that a researcher might find useful. By the 1970s the day-to-day collection and storage of data about musical instruments had begun to benefit from the new technologies of the computer and the hologram. Malm (1974, pp.119ff) developed a project ‘Musinst’ that called for the collaboration of musical instrument collectors in a commonly agreed programming of their material in the computer language of the IBM 360 Assembly System. He considered the hologram to be an important tool. Instead of the static view of a two-dimensional photograph that presents the same image from whatever angle it is viewed, a hologram reveals different elevations of the holographed object when the viewer changes position in relation to the viewing screen, as if he or she were actually moving around the real object. The close integration between hologram and computer banks of data envisaged by Malm came to fruition in the work of Ramey (1974), who developed a computer-dependent multivariate information storage and retrieval system based on the schemes of Hornbostel-Sachs and Dräger, and identifying ‘morphological’, ‘acoustic’ and ‘anthropological’ data.

Like many of his contemporaries, Herbert Heyde contributed to a shift away from limited-character classification, adopting a historical approach based on the structural, functional and mensural aspects of instruments and including factors related to the player’s body as well as mechanical and electronic ones. Likewise, Tetsuo Sakurai modified the Hornbostel and Sachs scheme to include primary resonators and secondary vibrators. René Lysloff and Jim Matson developed a ‘multidimensional scalogram analysis’ graphic method based on 37 variables grouped according to characteristics of the sounding body, the substance (supports, attachments), the resonator, sympathetic vibration, the sound instigator, the player–instrument relationship, the performance context, and the sound context and tuning.

Scientific ideas and methods influenced the study of musical instruments in other ways. Stockmann (1971; see also Elschek and Stockmann, 1967 and Becker, 1969) used the language of information theory and introduced cybernetic models. Although he acknowledged the value and usefulness of systematics in organology, he found that it prevented or at least made more difficult the development of a typology proper (1967). Systems are static; they proceed from sharp

divisions and categories that must provide for any contingency and be valid for all instruments – even imaginary ones. Stockmann also questioned the excessive concern with structural criteria that has prevailed in classification systems for musical instruments, because those criteria neglect functional relations that may render meaningless a system that limits itself to merely physical characteristics. He said of the new typological method that 'typological differentiation, that is, the isolation of variants, groups of variants and types, centres on a very simple, selective principle, namely the presence or absence of certain characteristic criteria' (1967, p.21). Typologists, in fact, 'proceed like the computer and scan the totality of the data they want to compare as to whether certain criteria do or do not occur'. Inevitably typologists require special graphic symbols to cope adequately with a multitude of phenomena. Elschek's elaborate tables of symbols (1967) account in minute detail for morphological and ergonomic features. A high proportion of Elschek's signs are iconic – tending, that is, to portray the phenomenon represented.

Heyde distinguished between 'natural' and 'artificial' systems of classification. The former take into account the historical genesis and development of the instruments; the latter are based on any arbitrary viewpoint that disregards 'genetic' factors. He included the Hornbostel-Sachs and Dräger systems in this second category. Heyde believed that modern systems generally identify the chain of elements by which a musical instrument translates into acoustic energy (i.e. sound) the nervous (or mechanical or electronic) energy that the musician (or machine or electric current) applies to the instrument. But the source of energy was itself occasionally used as a principle of classification.

Heyde's system allows for as many as 11 elements in the analytical diagram of an instrument; one relatively simple instrument, the bullroarer, belongs to Heyde's quarternary order, i.e. has four elements. Heyde's terminology and flow charts appeal to the expert in cybernetics. Nevertheless they deserve to be studied by the layman: they are extreme examples of the replacement of ordinary language by new scientific symbols arranged in diagrams. Heyde claimed that his own system was 'natural', i.e. genetic, in that he could correlate the number of elements in an instrument with its place in a cultural-historical sequence.

The desire, evident in Heyde's book, to place musical instruments in some kind of evolutionary sequence had already found strong expression in Sachs's *Geist und Werden der Musikinstrumente* (1929). Sachs derived his conclusions from a study of the worldwide distribution of musical instruments, reinforced where possible by archaeological and prehistoric evidence, ethnological theories and, for the more recent strata, historical facts. On the basis of these data he distinguished 23 strata. The earliest included instruments of universal distribution, such as corporeal percussion and rattling devices suspended from the body. The most recent, comprising the 2nd millennium CE, included instruments like the kettledrum, the *sanza* and certain lutes. Strata 1 to 12 represented the Stone Ages, 13 to 19 Antiquity, and 20 to 23 the Middle Ages. Hornbostel, in his study of the musical instruments of Africa (1933), reduced the original number of strata to seven, and Sachs himself (*SachsH*, pp.63–4) stated that 'for the purposes of this book, three will suffice: early, middle, and late'. Distribution studies and surveys rarely include information on the density of occurrence, either in relation to a limited area and society, or in worldwide terms.

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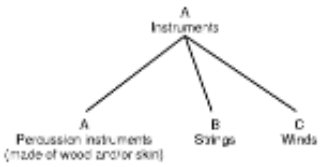
5. The study of classification systems.

The first cross-cultural, historical and cognitive-structural study of classifications of instruments and the concepts of instruments which govern them was presented by Kartomi (1990) who argued that to classify objects such as musical instruments is a fundamental principle of human thinking and that society's or individual's classifications of instruments tend to express that society's or individual's cultural assumptions. Kartomi distinguished between societies whose beliefs, practices, histories and classificatory schemes have been perpetuated largely by oral transmission (many South-east Asian, Pacific and West African societies) and societies marked mainly by literary transmission (many societies in Europe, the Middle East, China and South

Asia). Naturally much more historical source data is available for the latter. Some schemes are in a state of flux while others have persisted for centuries or even millennia. The data suggests that a culture or subculture normally has several co-existing ways of organizing information about musical instruments, ensembles or both, some of which may be based on a number of intersecting facets and others on single- or multiple-character steps of division. Some embody a culture's profoundest ideas or belief systems. In both kinds of societies classifications range from broad schemes (with few steps or categories) to close groupings (having a substantial number of steps). Late 19th- and early 20th-century comparative musicologists wrote for Western readership and therefore classified a society's instruments in a Western scholarly fashion rather than in native categories. Until recently, 20th-century classifications tended to be scholar-imposed, as in the case of Mahillon in Europe.



Single-step classification key

Scholar-imposed, or artificial, schemes normally take the form either of 'keys' (tree diagrams; see figs.3 and 4), with one 'character' (distinguishing feature) of division per step, or of 'typologies', applying more than one character or 'facet' (sharply defined aspect) for each step. 'Culture-emerging', or natural, schemes take the form of 'taxonomies' (fig.5), which apply one character of division at each step, or of 'paradigms', which apply more than one principle of division at each step. Both taxonomies and keys are based on downward classificatory thinking (logical division), starting from the general or abstract and moving to the specific, while paradigms are based on the horizontal and vertical intersection of facets. Typologies involve upward thinking, starting with the detail and moving to the more general or abstract. In the process of understanding a taxonomical problem, human beings continually alternate between upward, downward and lateral thinking, for example when trying to avoid inaccuracies, especially at the lower levels in downward schemes. Keys and typologies are schemes constructed for a particular semantic purpose, while taxonomies and paradigms grow from the individual cultural context and musical practice.


Three-dimensional typology of a European willow-bark flute

Oskár Elschek developed a method based on upward thinking, beginning by inspecting in detail the attributes of a group of objects (e.g. flutes) and classifying them according to increasingly higher levels of generality in order to isolate variants, groups of variants and types. He dubbed this method 'typological' and devised a set of special graphic symbols for it. Typologies, unlike keys, are based on a multi-character or multidimensional method of arranging objects according to the simultaneous intersection of categories, as exemplified in fig.6.

MUSICAL INSTRUMENTS			
PERCUSSION	WINDS	STRINGS	
		BOWED	PLUCKED

Sample taxonomy of instruments

Taxonomies of instruments apply one character of division per step (fig.7), while paradigms are groupings based on the simultaneous application of more than one dimension of an object. Among the Tiboli in the southern Philippines, for example, it is necessary to include both solo instruments and ensembles in the one scheme because some instruments are played only solo and others only in ensembles (fig.8). Since the Tiboli apply three main dimensions in simultaneous intersection in their classifications, their mode of classificatory thought is paradigmatic. The empty cells in the paradigm indicate that the Tiboli never use their lute and bowed string ensemble in the 'strong' musical style, nor their gong, drum and stick ensemble in the 'gentle' musical style, and that instruments played 'with the breath' are always played singly, never in ensemble.

Native classification schemes became important sources only in the post-colonial era (after *c*1970), beginning with scholars such as Hugo Zemp (1971, 1978). In view of the preoccupation of organologists with the method of classification by logical division, it can initially be surprising to learn that taxonomies and keys are not universally accepted as being the 'natural' way of classifying and that some societies have traditionally thought in terms of paradigms. There is no evidence that members of orally transmitting cultures such as the 'Are'are (Solomon Islands) or the Tiboli prefer to group instruments in rigidly ordered taxonomies by single-character division, though this mode of thinking is not foreign to them. We know that in many societies several parameters are taken singly or simultaneously into account when constructing taxonomies of instruments, which suggests that multifaceted division may be widespread.

The form of a scheme is related to a culture's hierarchial preferences for certain instruments. Thus, instruments that are highly valued in a culture are normally more intensively classified than

the less-important instruments; for example, in some Javanese schemes, gongs and drums, which are at the top of the hierarchy, are more closely subdivided than other instruments.

In a scheme based on the mode of sound excitation, the classifier's or culture's attitude to the way in which sounds are excited on an instrument partly or largely determines the number and content of categories. For example, if members of a culture regard beaten and plucked instruments as having different modes of excitation, they will classify them into those two separate categories, while members of a culture that regards beating and plucking as similar performing actions will subsume them into one category. The classification by the Roman writer Boethius is an example of the former while the scheme of the Hellenistic author Pollux and the dominant Dan (Côte d'Ivoire, Liberia) and Kpelle (Liberia) schemes of West Africa are examples of the latter.

Though many schemes throughout the world take the form of logical division, in some cultures instruments are classified primarily on morphological and acoustic grounds, and in others they are divided mainly according to functional symbols of cosmic or spiritual ideas, sexuality, royal character and aplomb, or as vessels housing various spirits of nature or the ancestors. Classifications of instruments resemble each other across the cultures most closely when based on mode of sound excitation or the single, purely musical factors, and they differ most strongly from each other when based on broader social, religious, or other belief structures. When strict logic comes into conflict with the functionality or simple systematic convenience of a scheme – that is, when ambiguous categories cannot easily be avoided – logic usually falls by the wayside. If logic is used as the evaluative standard, the observer is put in the position of dismissing most inferences as deviant, faulty, or not up to standard. Sometimes, indeed, loose ends are useful in that they can be interpreted as evidence of diachronic processes, as unwitting preservers of elements of change in terminologies or structures.

Schemes that fulfil the requirements of strict paradigmatic form or logical division and schematic symmetry are rare in any culture, whether or not it has a literary or an oral orientation. Sometimes a scheme has developed spontaneously to illustrate a particular idea and therefore had no need to incorporate all the diversity of detail into a watertight symmetry, nor to account for possible loose ends. Sometimes it has expanded, contracted, or changed in some other way at some point, and maintained some old components alongside the new, giving it a somewhat illogical or inconsistent appearance. Nomenclatures and terminologies may have changed in meaning or have been attached to different instruments in the course of time. Ambiguous or contradictory titles of categories or other lexemes are sometimes comprehensible only when regarded as reflecting historical change.

Inconsistencies in a scheme, whether apparent or real, and even if unaccountable, are partly attributable to the fact that the very imposition of boundaries creates problems: borderline cases always arise when boundaries are imposed. By its very nature a given instrumentarium used in practice cannot be fitted into a perfectly logical classification scheme. The reason for this is the very expansiveness and the creativity of the human beings who conceive of, fashion, and continually change the form and meaning of instruments. Our human minds may need such schemes to assist us to comprehend a diverse body of objects or ideas and to aid memory. However, we must reconcile ourselves to the fact that perfectly logical schemes that deal adequately with all aspects of a body of data simply do not evolve in living cultures, since the primary aim is virtually never to comply with the requirements of strict logical division.

Margaret J. Kartomi

APPENDIX: Introduction to the hornbostel-sachs classification system

Treatises on systems of classification are by and large of uncertain value. The material to be classified, whatever it may be, came into existence without any such system, and grows and changes without reference to any conceptual scheme. The objects to be classified are alive and dynamic, indifferent to sharp demarcation and set form, while systems are static and depend

upon sharply drawn demarcations and categories.

These considerations bring special difficulties to the classifier, though also an attractive challenge: his aim must be to develop and refine his concepts so that they better and better fit the reality of his material, sharpen his perception, and enable him to place a specific case in the scheme quickly and securely.

A systematic arrangement for musical instruments concerns first of all musicologists, ethnologists, and curators of ethnological collections and those of cultural history. Systematic arrangement and terminology are urgently needed, however, not only for collections of material, but also for their study and in its interpretation. He who refers to a musical instrument by any name or description he pleases, being unaware of the points which matter, will cause more confusion than if he had left it altogether unnoticed. In common speech technical terms are greatly muddled, as when the same instrument may be indiscriminately called a lute, guitar, mandoline or banjo. Nicknames and popular etymology also mislead the uninitiated: the German *Maultrommel* is not a drum, nor the English jew's (properly 'jaw's') harp a harp, nor the Swedish *munngiga* a geige ('fiddle'), nor the Flemish *tromp* a trumpet; only the Russians are correct when they call this same instrument, a plucked lamella, by the uncommitted term *vargan* (from Greek *organon*, 'instrument'). Homonyms are no less dangerous than synonyms: the word 'marimba', for instance, denotes in the Congo the set of lamellae usually called 'sanza', but elsewhere it denotes a xylophone. Ethnological literature teems with ambiguous or misleading terms for instruments, and in museums, where the field-collector's report has the last say, the most senseless terms may be perpetuated on the labels. Correct description and nomenclature depend upon knowledge of the most essential criteria for the various types – a condition which, as a visit to a museum will show, is hardly ever met. One will find, for instance, that oboes, even when still in the possession of the double reed which unmistakably proclaims them for what they are, are noted as flutes, or at best as clarinets; and should the oboe have a brass bell one may be certain of the label 'trumpet'.

A system of classification has theoretical advantages as well as practical uses. Objects which otherwise appear to be quite unrelated to each other may now become associated, revealing new genetic and cultural links. Herein will always be found the leading test of the validity of the criteria upon which the system is based.

The difficulties which an acceptable system of classification must surmount are very great, since that which suits one era or nation may be unsuitable as a foundation for the instrumental armoury of all nations and all times. Thus the ancient Chinese based their classification on material, distinguishing between instruments made of stone, metal, wood, gourd, bamboo, hide and silk; consequently, to them, trumpets and gongs, stone harmonicas and marble flutes, shawms and clappers, each belonged together.

Our own present-day practice does not amount to much more. Sound-instruments are divided into three major categories: string instruments, wind instruments and percussion instruments. This cannot be defended even on the grounds that it satisfies day-to-day requirements. A large number of instruments cannot be fitted into any of the three groups without placing them in an unnatural position, like the celesta, which, as a percussion instrument, is brought into close proximity to drums and so on. As a remedy one introduces a fourth group under the disconcerting heading 'miscellaneous' – in any systematic grouping an admission of defeat. Moreover, the current classification is not only inadequate, but also illogical. The first requirement of a classificatory system is surely that the principle of demarcation remains the same throughout for the main categories. Our customary divisions, however, follow two different principles, string instruments being distinguished by the nature of the vibrating substance but wind and percussion by the mode of sound-excitation – ignoring the fact that there are string instruments which are blown, like the Aeolian harp, or struck, like the pianoforte. The customary subdivisions are no better. Wind instruments are divided into woodwind and brass, thus giving a subordinate criterion of differentiation, namely, material, an unjustifiable predominance and flagrantly disregarding the fact that many 'brass' instruments are or were once made of wood, like cornetts, serpents and bass horns, and that in any case many 'woodwind instruments' are optionally or invariably made of metal, as flutes, clarinets, saxophones, sarrusophones, tritonicons etc.

The objections which can be raised against the crudity of the customary divisions are now familiar to organology (*Instrumentenkunde*), and in recent decades scholars have made more than one

attempt to attain something more satisfactory. Leaving aside classifications which have owed their structure to the peculiarities of this or that collection, catalogues have latterly in general adopted a system which Victor Mahillon has used since 1888 for his comprehensive catalogue of the Museum of the Brussels Conservatory.

Mahillon takes the nature of the vibrating body as his first principle of division, and thus distinguishes between instruments (1) whose material is sufficiently rigid and at the same time sufficiently elastic to undergo periodic vibration, and named by him ‘self-sounding instruments’ (*instruments autophones*; for reasons which Sachs has explained in his *Reallexikon der Musikinstrumente*, Berlin, 1913, p.195*a*, we prefer the term idiophones); (2) in which sound waves are excited through the agency of tightly stretched membranes; (3) in which strings vibrate; and lastly (4) in which a column of air vibrates. Thus he distinguishes four categories: self-sounders, membrane instruments, string and wind instruments. Besides the uniformity of its principle of division, the system has the great advantage in that it is capable of absorbing almost the whole range of ancient and modern, European and extra-European instruments.

Mahillon’s system of four classes deserves the highest praise; not only does it meet the demands of logic, but also it provides those who use it with a tool which is simple and proof against subjective preferences. Moreover, it is not so far removed from previously used divisions as to offend well-established custom.

It has seemed to us, however, that the four-class system stands in pressing need of development in fresh directions. Mahillon started on the basis of the instruments of the modern orchestra, with which, as an instrument manufacturer and musician, he was in closest contact, and it was these which gave him the initial challenge to work out his system. Then, as the collections of the Brussels museum grew under his direction, he explored over years of relentless effort the limitless field of European and exotic organology. Inevitably a newly acquired specimen would now and then fail to fit into the system, while certain subdivisions which figure importantly among European instruments – e.g. those of keyboard and mechanical instruments – assumed an unwarrantably prominent place. Mahillon had indeed been led, for the sake of the European instruments, to juxtapose categories which did not logically build a uniform concept. Thus he divided the wind instruments into four branches, (1) reed instruments (*instruments à anche*), (2) mouth-hole instruments (*instruments à bouche*), (3) polyphone instruments with air reservoir and (4) cup-mouthpiece instruments (*instruments à embouchure*). Consider too the drums, which he grouped as frame drums, vessel drums and double-skin drums; he consequently divided the skin drums corresponding to our side- and kettledrums – and likewise the *autophones* – into instruments of untuned pitch (*instruments bruyants*) and those of tuned pitch (*àintonation déterminée*). This is an awkward distinction, since a wide range of transitional sounds occurs between pure noises and noise-free tones; indeed, save for a few laboratory instruments, there are no sound-producers that can truly be said to yield either pure noise or pure tones, the sounds of all the usual musical instruments being more or less wrapped in noise. Mahillon later seems to have sensed this when he contrasted noise-instruments with those *à intonation nettement* or *intentionellement déterminée*; but the criterion is subjective and as a rule incapable of proof.

In general, Mahillon was right to subdivide the four main classes into ‘branches’ differentiated by playing action. Yet for string instruments it was a dubious procedure; a violin remains a violin whether one bows it with a bow, plays it pizzicato with the fingers, or strikes it *col legno*. Perhaps this seems a lopsided argument, since the violin is, after all, designed to be bowed. But there are other instances. One could cite instruments whose playing action has changed in the course of time but whose form has remained unaltered. This was the case, for example, with the ancient Celtic *crowd* [crwth], which can be proved to have been plucked in the earliest times, but which came to be bowed in the High Middle Ages: should the history of instruments therefore deal with it half in a chapter on plucked string instruments and half in one on bowed, although the instrument itself remains just the same? Then there is the psaltery, which is turned into a dulcimer (*Hackbrett*) when the player uses beaters; should one, in a collection, separate the psalteries, otherwise indistinguishable from each other, into two groups on the grounds that in one country of origin it was customary to pluck it but in another to beat it? Should I place the clavichord and the pianoforte side by side but house the harpsichord with the guitars because its strings are plucked?

All these considerations have persuaded us to undertake afresh the attempt to classify musical instruments. We were fortunate in having at our disposal as a ready-made base the large and

extensively described collections of the Brussels museum out of which Mahillon's system had grown. At the same time we are aware that with increasing knowledge, especially of extra-European forms, new difficulties in the way of a consistent classification will constantly arise. It would thus seem impossible to plan a system today which would not require future development and amendment.

Like Mahillon, we accept the physical characteristics of sound-production as the most important principle of division; but even at this point considerable difficulties are met since acoustic physics has so far covered but the smallest fraction of the preliminary investigations. Thus inadequate research has yet been undertaken on the sound-production of the bullroarer, the vibratory manner in north-west American 'ribbon-reeds', the vibration events in bells, gongs, kettledrums, plucked drums, and wind instruments with free reeds and finger-holes. To such difficulties must be added others arising from the morphology of instruments. The problem of defining the term 'frame drum' (*tamburin*) for example, is scarcely capable of satisfactory solution; undoubtedly the typical frame drum represents a concise concept not to be disregarded in any classificatory system, but the transition between this and the pronouncedly tubular drum occurs without a break, often making it impossible to decide on the basis of shape whether a specimen belongs to the one kind or to the other.

Other obstacles in the path of the classifier are instruments showing adulterations between types (*Kontaminationen*). The fact of adulteration should be accounted for by placing such instruments in two (or more) groups. In museums and catalogues these cases will be arranged according to the dominant characteristic, but cross-references to other characteristics should not be omitted. Thus, among instruments of every class one may find rattling devices which belong to the inventory of idiophones – a feature which cannot be taken into account when placing the instrument in the classification. But where the adulteration has led to an enduring morphological entity – as when kettledrum and musical bow combine in a spike lute – it must have a place of its own within the system.

We must refrain from arguing our subdivisions in detail. Whosoever will check these critically, or test them in practice, will doubtless repeat the lines of thought which are not set out here, with minor variations of his own.

In classifications it is often customary to indicate the ranking of divisions within the system by means of specific headings, as especially in zoology and botany with expressions like class, order, family, genus, species, variant. In the study of instruments, Mahillon himself felt this need and met it by introducing the terms *classe*, *branche*, *section*, *sous-section*; on Gevaert's advice he refrained from using the term 'family' on account of its widely known use for instruments of like design but of different sizes and pitches.

We consider it inadvisable to maintain consistent headings throughout all rubrics for the following reasons. The number of subdivisions is too big to manage without bringing in a petty superfluity of headings. Moreover, in any system one must leave room for further division to meet special cases, with the result that the number of subdivisions could for ever increase. We have purposely not divided the different main groups according to one uniform principle, but have let the principle of division be dictated by the nature of the group concerned, so that ranks of a given position within a group may not always correspond between one group and another. Thus terms like 'species' may refer in one case to a very general concept but in another to a highly specialized one. We therefore propose that the general typological headings be restricted to the topmost main groups, though one could, like Mahillon, speak of the four main groups as classes, of the next divisions (with a two-unit symbol [*zweiziffrig*]) as sub-classes, the next (three-unit) as orders, and the next (four-unit) as sub-orders.

We have refrained from providing a subdivision containing no known existing representative, save in cases where a composite type may be assumed to have had a precursor in a simpler type now extinct. Thus it can be assumed from analogy with numerous types that Man rubbed a solid, smooth block of wood with the moist hand before he ever carved a series of differently pitched tongues by cutting notches into the block, as in the friction block of New Ireland. Again, where the wealth of forms is exceptionally vast, as with rattles, only the more general aspects of their classification can be outlined in the scheme, and these will certainly require further elaboration.

In general we have tried to base our subdivisions only on those features which can be identified from the visible form of the instrument, avoiding subjective preferences and leaving the

instrument itself unmeddled with. Here one has had to consider the needs not only of museum curators but also of field workers and ethnologists. We have carried the subdivisions as far as seemed important for the observation of cultural history and detail, though the plan of the whole classification makes possible its application to the material either summarily or in great detail as desired; general treatises and smaller collections may not require to follow our classification to its last terms, while specialist monographs and catalogues of large museums may well wish to extend it in further detail.

The application of our findings in describing and cataloguing is substantially facilitated by use of the Dewey numerical system (since the numerical arrangement for the Bibliographie Internationale of musical instruments applies only to European instruments, and is anyhow as inadequate as can be, we have planned our own numerical order independently). If those in charge of large collections who issue catalogues in the future decide to accept our numerical arrangement, it will become possible to find out at first glance whether a given type of instrument is represented in the collection.

The ingenuity of Dewey's idea lies in the exclusive use of figures, replacing the more usual conglomeration of numbers, letters and double letters by decimal fractions. These are so used that every further subdivision is indicated by adding a new figure to the right-hand end of the row; the zero before the decimal point being always omitted. Thus it becomes possible not only to pursue specification to whatever limits one desires and with never any trouble in the manipulation of the numbers, but also directly to recognize from the position of its last figure the ranking of a given term with the system.

It is also feasible in a row of numbers to divide off any set of figures by points. Say, for example, that it is a bell chime (*Glockenspiel*) which is to be coded and placed in the system. In the context of the system we are dealing with an idiophone, the class to which the initial code-figure 1 is allotted. Since the instrument is struck it belongs to the first sub-class, and so another 1 is added (struck idiophones = 11). Further addition of relevant code-figures produces the ranking 111 since it is struck directly; and then, as a struck-upon (i.e. percussion) idiophone, it earns a fourth figure, in this case 2 (1112 = percussion idiophones). Further specification leads to 11124 (percussion vessels), 111242 (bells), 1112422 (sets of bells), 11124222 (sets of hanging bells) and 111242222 (ditto with internal strikers) – obviously, everyone must decide for himself how far to go in a given case. Instead of the unmanageable number now arrived at, we write 111.242.222. The first cluster shows that we are dealing with an idiophone that is struck directly, while the second and third together imply that we are dealing with bells.

Common considerations among all instruments of a class – e.g. with membranophones the method of fixing the skin, and with chordophones the playing method – may be noted with the aid of figures appended to the essential code-number by a dash: the pianoforte would be entered as 314.122–4–8 and the harpsichord 314.122–6–8, because 8 represents the keyboard, 4 the hammer playing-action and 6 the plectrum playing-action, both instruments having the same main number indicating board zithers with resonator box.

Any of the subordinate criteria of division may, if desired, easily be elevated and treated as a higher rank in the classification, by switching the positions of figures. Thus, for a bagpipe in which chanter and drone are both of the clarinet type, the code-number would read 422.22–62, i.e. a set of clarinets with flexible air reservoir. But if, for instance in a monograph on bagpipes, one wished to especially distinguish these (i.e. chanter and drone) features, one could write 422–62:22, i.e. reed instrument with flexible air reservoir whose pipes are exclusively clarinets.

Conversely, in order to bring closer together groups which are separated in the system, it is possible to turn a main criterion of division into a subordinate one without destroying the system: one simply replaces the first relevant figure by a point (.) and then adds it after a square bracket (]) at the end of the number. Thus in the example of bagpipes, it might be important to specify these instruments as always polyorganic (i.e. composed of several single instrumental units) but with components which are sometimes clarinets and sometimes oboes; instead of 422–62:22 = reed instrument (*Schalmeieninstrument*), with flexible air reservoir, polyorganic, composed of clarinets, it might be preferable to write 422–62: . 2 = set of reedpipes (*Schalmeienspiel*) with flexible air reservoir = bagpipe, and then to differentiate further by writing 422–62: . 2]1 = bagpipe of oboes, or 422–62: . 2]2 = bagpipe of clarinets. (This use of the symbols – :] is slightly different from that of the Classification Bibliographique Décimale, but is nevertheless within its spirit. The rules are:

the dash is employed only in connection with the appended figures listed in the tables at the end of each of the four main sections; subdivisions beyond these are preceded by a colon [thus 422–62 = reed instrument with flexible air reservoir, but 422–6: 2 = 422.2–6 = oboe with air reservoir]; subdivision answering to the omission of a figure is preceded by a square bracket.)

Other specifications applying to a subordinate group are suffixed to the code-figures of the latter, e.g. 422–62: . 2]212 = a bagpipe of clarinets with cylindrical bore and finger-holes.

These innumerable cases in which an instrument is composed of parts which in themselves belong to different groups of the system could be indicated by linking appropriate figures by a plus sign. One then avoids repetition of a number common to both such parts, writing this number once and following it with a point: a modern trombone with slide and valve would then appear not as 423.22 + 423.23, but as 4232.2 + 3, and similarly bagpipes composed partly of clarinets and partly of oboes, as cited above, would become 422.62: . 2]1 + 2.

In certain circumstances it may be necessary not only to rearrange the rankings of the concepts and create new subdivisions, but also to incorporate into the higher ranks of the classification some criterion which has purposely not so far been used. There is nothing to prevent this being done, and we should like to illustrate it by a final example, at the same time showing how we envisage the development of our system for special purposes. Let us imagine the case of a monograph on the xylophone. The system divides struck idiophones (111.2) by the shape of the struck bodies, thus: struck sticks (111.21), struck plaques (111.22), struck tubes (111.23) and struck vessels (111.24). Xylophones could fall into any of the first three, but the shape of the sounding bodies is here of little relevance – the transition from sticks to plaques being quite fluid – and so the fifth figure may be removed, and, if desired, added as]2 at the end. For the sixth figure we insert 2, if the description is to concern only multi-tone instruments, giving 1112. .2 = sets of struck idiophones (*Aufschlagspiele*). We must, however, exclude sounding bodies of metal, stone, glass etc., and must therefore create a subdivision according to material which the system does not already provide, thus:Further stages in this classification of the xylophone would make use of morphological criteria significant from an ethnological point of view:

Classification
1112. .21.1 *Bedded xylophone*: the sounding bodies rest on an elastic foundation
1112. .21.11 *Log xylophone*: the foundation consists of separate logs; there is generally a shallow pit in the ground beneath the sounding bodies (found in Oceania, Indonesia, East and West Africa)
1112. .21.12 *Frame xylophone*: the bearers are joined by cross rods or bars
1112. .21.121 *Rail xylophone*: the frame hangs from the player's neck on a sling and is kept clear of his body by a curved rail (South-east, East and West Africa)
1112. .21.122 *Table xylophone*: the frame is borne on a trestle (Senegal and the Gambia)
1112. .21.13 *Sledge xylophone*: the sounding bodies lie across the edges of two boards (Central Africa)
1112. .21.14 (*Bedded*) *trough xylophone*: the sounding bodies lie across the edges of a trough- or box-shaped vessel (Japan)
1112. .21.2 *Suspension xylophone*: the sounding bodies lie on two cords without any other foundation
1112. .21.21 (*Free*) *suspension xylophone*: without case (southern Vietnam)
1112. .21.22 (*Suspension*) *trough xylophone*: with trough-shaped box (Myanmar, Java)

Rail xylophones and table xylophones are to be further subdivided thus: 1 without resonators; 2 with resonators; 21 with resonators suspended singly; 22 with resonators struck into a common platform. The resonators, in most cases gourds, often have holes sealed by a membrane, showing adulteration with 242 (vessel kazoos). Possibly the method of mounting the membranes (directly, or over a cone-shaped frame) will demand another subdivision. One can, however, dispense with adding another number since frame xylophones without resonators are unknown.

Appendix reprinted from Hornbostel and Sachs, 1914 (by permission of Limbach Verlag, Berlin), Eng. trans., 1961/*R*

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