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About a new systematic classification of musical instruments[1]

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Currently there is no general classification of musical instruments, especially in ethnology, which in its essential features does not tie in with the classification invented by Victor Mahillon and presented for the first time in 1878 in the *Annuaire du Conservatoire royal de musique de Bruxelles*[2] and then at the beginning of his first *Catalogue descriptive et analytique du musée instrumental* of the same conservatory[3]. Erich M. von Hornbostel and Curt Sachs in their "Systematik der Musikinstrumente" published in the *Zeitschrift für Ethnologie* in 1914[4], Dr. George Montandon (Lausanne) in his *Généalogie des instruments de musique* serving as an introduction to his encyclopedic catalog of musical

[1] I would like to thank Messrs. Lionel de La Laurencie, Marcel Mauss, Paul Rivet, and Georges Henri Rivière for their criticism and suggestions regarding the present classification. I likewise thank Mr. David Weill for his generosity towards the department of organology at the Trocadéro Museum of Ethnography. A first sketch of this classification has appeared in vol. 1 of the *Bulletin Du Musée d'ethnographie du Trocadéro* (January 1931), pp. 21-25. Cf. likewise "Des instruments de musique dans un musée d'ethnographie", in *Documents* vol. 5 (October 1929), pp. 248-254.

[2] Brussels, Librairie européene C. Muquardt, vol. 2, 1878, pp. 81-256.

[3] Gand, typ. C. Annoot-Braeckman, 1880. – This precious volume was reprinted in 1893 and succeeded by another three no less remarkable ones (1900-1912). The catalog formed the basis of all organological studies for a long time.

[4] Vol. 4/5, pp. 553-590.

instruments of the Museum of Ethnography in Geneva in 1919[5], and finally more recently Walter Kaudern in volume III of a study about his ethnological journey to the isle of Celebes (1917-1920)[6] only repeat Victor Mahillon's division into four main classes. Any more individual interpretation does not appear before the subdivisions of a morphological or genetic character. Therefore, we cannot insist enough on Mahillon's merit. Without the precedent of any classification and only by dedicating himself to studies of acoustics and instrument making,[7] he established the principle of a division, which the majority of ethnologists go along with. Further, it is true that the authority of Curt Sachs and Erich M. von Hornbostel contributes considerably to the spread of his ideas.

Mahillon's most important initiative is to abandon the old division after 1878 – which is still in use today[8] - into string, wind, and percussion instruments. Previously, in 1874, when he published his *Éléments d'acoustique musicale et instrumentale,*[9] he dedicated only a short chapter to the issue of the vibration of rods, edges, tone bars, and membranes. In summary, he concluded the following: "The musical instruments which we have just described actually do not have a musical nature; therefore their role is restricted in most cases to indicate the rhythm".[10] In November 1876, raja Sourindro Mohun Tagore, director of the Calcutta Music School, donated 98 Hindu instruments to the Belgian king.[11] When added to those willed by Fétis, these instruments constituted the basis of a museum of musical instruments annexed to the Music Conservatory of Brussels. As of January 1, 1877, Mahillon was appointed director of this museum, and less than two years later his catalog appeared. Without a doubt, glimpsing the infinite diversity of non-European instruments made clear to him that it was no longer possible to limit oneself to current divisions which miss one or another type of instrument. For example, being

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[5] "Généalogie des instruments de musique et les cycles de civilisation", in *Archives suisses d'anthropologie générale*, III-1, 1919, and special edition (Geneva, Kundig, 1919).

[6] *Musical instruments in Celebes* (Göteborg, Elanders boktryckeri, 1927).

[7] Mahillon ran a company – which was founded by his father – for the manufacturing of wind instruments.

[8] It figures notably in the work of Dr. E. T. Hamy, *Les Origines du Musée d'ethnographie* (Paris, 1890), which does not correct Jomard's "classification méthodique des produits de l'industrie extra-européenne" (1862) in this regard.

[9] Brussels, C. Mahillon.

[10] Op. cit., p. 208.

[11] Mahillon, *Catalogue descriptif*, vol. I, 2nd ed., pp. 90-158. – Probably around the same time raja Sourindro Mohun Tagore donated 171 Hindu instruments to the Music Conservatory of Paris (nos. 792b, 793b, 794b, 795-881, 1277-1357 of the inventory.

neither a string nor wind instrument does not merit classification as a percussion instrument. Keeping the common and restricted sense of the latter term, Mahillon – in the same way as we consider it in this study – must have been astounded by the impossibility to group cymbals, gongs, drums, Cochinchinese and African xylophones, the Congolese "zanza" or the French "nail violin" [lit., iron violin][12] into one category. Apart from the diversity of the materials set in vibration, the procedures of hitting, plucking or rubbing which are applied to them have nothing in common. By the way the word percussion, beyond the pejorative undertone which it tends to try hiding, hardly seemed to be appropriate in a division in which the two primary terms – string and wind instruments – denominate the form or the condition of the body set in vibration. It [the word percussion] itself indicates only the mode of excitation of a body.[13] Furthermore, this word also suffers from imprecision, at least from excessive generalization: would not the cymbalum and the piano merit being listed among the percussion instruments just as the xylophone, the celesta or the kettledrum? Does not the same procedure of hammering operate undiscriminatingly on strings, wooden bars or membranes? Finally, does not the Arab treatise by Al Farabi on music go as far as to let all sound be generated by an impact or a percussion be it by "the human hand" or "the respiratory organ which repulses the air from the inside of the chest to outside the mouth"[14]?

Thus, Mahillon removes the words percussion and drums from the primary terms of his classification, and parallel to the string and wind instruments creates the two classes of *membranophones* and *autophones*. He contrasts the variety of kettledrums, [other small] drums, and bass drums – where "the sound is produced by the vibration of membranes which have become elastic by tension" – with

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[12] Cf. nos. 14, 99-106, 107, 108, 166, and 302 in Mahillon's catalog.

[13] One is surprised that the authors, who should be the most prudent in these matters, still seem to stick to European prejudices: thus, Mr. Stephen Chauvet in his study on the *Musique nègre* (Paris, Société d'éditions géographique, maritimes et colonials, 1929) subdivides the Negro instruments into "rhythm instruments" (drums, horns, whistles, rattles) and "*musical* instruments *in the classical meaning*" (emphasis mine).

[14] French translation by the Baron d'Erlanger (Paris, Geuthner, 1930), p. 8. Father Mersenne notes sharp-wittedly in his *Harmonie universelle* (Livre septiesme des instruments de percussion): "All bodies which make noise and produce a perceptible sound when struck can be grouped as percussion instruments and hence string instruments can be treated in the present book because one strikes them with the thumb or with a feather or otherwise; but because the striking is so slight that it must rather be called a simple touching or a simple pulling rather than a stroke or a percussion, one usually distinguishes those which one beats with a hammer or a stick from those which one touches in another way" …

various types of instruments "where the sound is sustained by the elasticity of the bodies themselves".[15] "We call these instruments *autophones* – he declares – and they are made of solid bodies and themselves sufficiently elastic to sustain the vibrational movement which is provoked by one of the three following modes of excitation: striking, plucking, and rubbing [friction]".[16] The selfsame definition clearly and – we believe – for the first time distinguishes between the procedure of sound emission and the body which is its object. Furthermore, it unveils the existence of instruments which European organology had so far disregarded and which are of such abundance that the three classic modes of excitation of strings – striking, plucking, and rubbing – apply equally well to them. Just as the piano constitutes an instrument with struck strings, just as the harp, the guitar and the harpsichord require the plucking of their strings, and just as the violin necessitates a bow to rub the strings, instruments without strings or membranes do exist consisting of wood, metal or stone, which can be struck, plucked or rubbed just as a common string. Thus, the plucked string of the guitar corresponds to the rattan or metal plucked on the African *zanza*; the struck string of the piano corresponds to the wooden slab hit on the African *balafo* or the South American *marimba;*[17] and the rubbed string of the violin corresponds to Franklin's crystallophone or *Glasharmonika*. The attention refers to a variety of procedures that are absolutely "musical" although they are executed with sound materials more or less uncommon in Europe. "All elastic bodies – writes Mahillon – be they solid, liquid or gaseous, can produce sounds; but the construction has necessarily limited the choice of materials to those where the vibrational movement can be effectuated most easily. Among the solid ones it uses strings, membranes, wood, glass, metals, stone, etc. Among the gaseous ones, air".[18] Hence, the four classes of instruments so far satisfying the "ingenuity" of man were derived and, in the terminology adopted in 1914 by Curt Sachs and Hornbostel, these classes became the *chordophones*, *membranophones*, *idiophones*, and *aerophones*.

As an additional feature, Mahillon's classification does not distinguish wind instruments according to the material – wood, brass, etc. – of their wall. Since in this case the sound is produced only "by the vibratory movement of air", a flute can be made of wood, silver or even of crystal without significantly changing its timbre – under the condition

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[15] Mahillon, *Catalog descriptif*, vol. I, 2nd ed., p. 3.

[16] Idid. p. 5.

[17] Father Mersenne, in his *Harmonie universelle* (Traité des instruments à chords, proposition XXVI), calls xylophones "wooden regals" and adds that they are "comparable to the spinets" and that their sounds "give as much pleasure as those of other instruments".

[18] Ibid., pp.1-2.

of more or less equal roughness and resonance of the wall. The old division between "woodwinds" and "brass" seems to be all the more unfounded as many flutes are made of metal – and trumpets were made of a different material than copper.[19] According to Mahillon, it is important to distinguish the type of body subjected to a vibratory movement: string, membrane, air column or any object sufficiently elastic in itself to become an autophone. In this case the material of the string or tube itself does not come into play but only the fact that some kind of tensioned string or an air column enclosed in some kind of tube is excited. [This is a] purely acoustical issue where the focus is set on the essential quality of what is vibrating.

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But let us come back to the idea of *autophone* or *idiophone* introduced by Mahillon. As justified as the established distinction between membranophone and autophone may be – so that a drum with a membrane cannot be confused with a bronze bell or woodblock – and as clear as the notion of membranophone itself may be, the class of autophones nevertheless appears to be rather poorly delimited. And in it the remnants of the old class of percussion instruments appear; here everything that does not fit elsewhere is grouped.

Drawing on Mahillon's as well as on Curt Sachs's and Hornbostel's class of *idiophones,* Dr. Montandon presents its most precise definition: each body enters here "whose vibration – he writes – is the result of its body and not of membranes, strings or primarily air".[20] Whereof we see that one of the most significant instruments of African organology, the *sanza*, investigated by the way especially by Dr. Montandon,[21] does not fit the characteristics of an *idiophone*; primarily vibrating here is not the instrument's "body" but the tongues or keys made from rattan or metal fixed on a small usually wooden board.[22] And in the very frequent cases where this slat is hollowed out or even replaced by a real sound box, the same relationship exists with the vibrating keys as between the strings of a violin and its body or soundboard. Although the violin and the guitar belong to the chordophones, and the sanza differs essentially because of the lack of tension of its keys, would it not be less absurd after all to approximate it to the former than to relegate it to the idiophones such as bells, jingles or triangles where the vibration

[19] Thus, pan flutes exist that are made of reed, stone, clay, and feathers; trumpets are made of brass and of bark as well.
[20] Montandon, op. cit., p. 47.
[21] Op. cit., pp. 26-43.
[22] The Musée de Congo in Tervueren possesses a sanza with metal keys fixed on a skullcap.

pertains to the whole "body"? – For comparable reasons xylophones and metallophones with wooden or metal keys, which differ considerably just as the body on which they are mounted, should not be assigned to the class of idiophones. However ingenious the indigenous people may have been in amplifying the tones by multiple resonators or a single one: the vibration of the wooden or metal plaques, as the strings of the violin or the tongues of the sanza, is the crucial factor which can by no means be confused with the secondary factor of the excitation of the resonators. Why else, theoretically, would the violin display more characteristics of a chordophone than of an idiophone? Why should its body be of less importance than its strings while for the xylophone everything happens as if the action of the body would outbalance that of the wooden keys? – With certain slit drums, such as the two-tone Mexican *teponastli* [teponaztli], the percussion is executed on tongues partly detached from the drum, which acts as a resonator: it [this instrument] is an in-between between a xylophone and a pure idiophone. Thus, teponastli, xylophone, and sanza represent various distinct stages, and we could think that in relation to them Mahillon in his very judicious endeavor has stopped mid-way. After isolating the membrane instruments should he perhaps have separated a class of instruments from the pure *autophones* which do not possess a single vibrating body? But what would he have gained by splitting the struck wooden instruments or by separating the gong or the bell from the metallophones? His classification of four types of instruments still reveals a slight deficiency, though a remedy is presented here.

More illogical than these four major divisions seem to us the subdivisions according to the mode of excitation of each material. First, does this not mean returning to the mediocre precision of terms such as *plucking* or *percussion*? Struck, plucked, and rubbed autophones; struck and rubbed membranes; and rubbed, plucked, and struck strings: these are the "branches" in which severely summarized Mahillon's classification is subdivided – while leaving aside the wind instruments. Without a doubt, be it in an abundant or moderate way, Hornbostel and Sachs, just as Dr. Montandon and Walter Kaudern, strive for establishing distinctions that acknowledge a complexity of instrumental procedures much larger than Mahillon, being far away from any ethnological study, had grasped.[23] But none of the proposed systems then escape the fault of classifying according to modes of vibration and at the same time according to vibrating bodies. Thus, Hornbostel and Sachs, like Dr. Montandon and Kaudern, divide the idiophones according to the way in which they are excited: clappers

[23] As far as all of these classifications are concerned cf. op. cit., as well as the important study by Curt Sachs, *Geist und Werden der Musikinstrumente* (Berlin, Reimer, 1929).

(*Gegenschlagidiophone*), percussion idiophones (*Aufschlagidiophone*), shaken idiophones (*Schüttelidiophone, rattling idiophones*), scraped idiophones (*Schrapidiophone*), plucked idiophones (*Zupfidiophone*), split idiophones (*Reißidiophone*), friction idiophones (*Reibidiophone*), etc. As far as the membranophones and the chordophones are concerned, Dr. Montandon is the only one to apply the same two "functional principles" – percussion and plucking – which he had also used for the idiophones. This unity is ignored in the classifications of Hornbostel-Sachs and Kaudern, who have adopted subdivisions according to the form of instruments: frame drums (*Rahmentrommeln*), kettledrums (*Kesseltrommeln*), tubular drums (*Röhrentrommeln*); and bar zithers (*Stabzithern*), tube zithers (*Röhrenzithern*), raft zithers (*Floßzithern*), spike lutes (*Spießlauten*), and necked lutes (*Halslauten*). But because Dr. Montandon omitted friction [rubbing] among his "functional principles", no distinction is established between the short plucking of harps or guitars and the prolonged, soft, and at the same time more intense rubbing of strings with a bow: a distinction which seems essential to us *as long as we only consider the procedure of* [exciting a] *vibration.*[24] Whether a neck is present in a chordophone required much more attention on the behalf of Dr. Montandon who ever since has drawn nearer to Hornbostel-Sachs and Kaudern by laying the bases of a classification of chordophones around several types of instruments – bow, lyre, harp, zither, and guitar. With the aerophones there is unanimous agreement to adopt *physical* divisions: tube, reed, and natural reeds of the lips.

In summary, would it not have been preferable to remain true to a single system of classification in each case and not to distinguish from case to case according to the type of vibrating material, the procedure of vibration, and the types of instruments? Moreover, since Mahillon had avoided a word such as *percussion* in the primary terms of his classification, would it not have been more rational to reject the word or any other comparable one which designates how one proceeds to excite an idiophone, a string or a membrane from the range of sub-divisions, too? We believe that a more stringent method would have prohibited the least attempt to classify according to procedure.

There are three kinds of arguments against such a classification based on the modes of vibration. First, the same instrument may require several different techniques: be it that the performance of the

[24] "The use of a bow – writes Dr. Montandon – does not change the character of the instrument which genealogically remains to be a guitar" (op. cit., p. 61). Being an accessory the violin bow nevertheless requires a specific distance of the strings – in the case of more than two; furthermore it also concerns the history of the musical bow. The introduction of the violin bow and the bowed string appears to us to be an organological event which sufficed to be included in any classification depending on the musician's gesture.

musician effortlessly moves on from one to another one, or be it that over time or in another region the techniques have undergone an evolution. The violin, an instrument with rubbed strings, does also allow plucking (*pizzicato*) and to a certain extent striking (*marcato*). The guitar or the lyre have their plucked strings, but in addition to their longitudinal rubbing called *glissando,* they allow striking, even that of the soundboard. The zither may be plucked simultaneously with a plectrum or the fingers, and the harpsichord may sometimes even be thought of as a percussion instrument due to the mechanical force with which the jack [French: sautereau] hits the string. Instruments with tensioned and plucked bark such as the Madagascan *valiha* are struck in the region of Java. It has to be noted, though, that such a divergence of techniques for one and the same instrument is not found among the aerophones except for the insignificant case of nose flutes where the air emitted through the nostril nevertheless conforms to the usual band form. Secondly, the term used – plucking, rubbing, striking – cannot truly express the musician's gesture. For example, owing to the direct contact of the finger with the strings of the guitar or the harp, some nuances of touching do not allow one to determine exactly whether it is a matter of striking or plucking; all we know is that the strings are excited. In the same way, doubts may exist concerning the precise application of the terms rubbing, scraping, and tearing[*]. Finally, an instrument stemming from prehistory or ethnology may be known but not its performance technique. Everything seems to make us believe that a bark zither is plucked. By chance, however, we found that it is struck. It seems prudent, therefore, to always allow for changes due to our future findings concerning instrumental possibilities.

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Despite certain advantages, the classification of Mahillon and his successors prompts ambiguity by using the term *idiophone* as well as by the tendency to always bring about a division based on the modes of sound excitation. However, these may be difficult to define or need to be ignored in case of lack of evidence. We believe that a better basis of classification could be assured by elements of an evident and undisputable nature so that one immediately recognizes them without requiring musical experience. This would make this endeavor also more accessible to ethnologists and prehistorians. We find these elements in the physical material of the body – which the musician originally excites directly – independent of other parts of the instrument – which prolong, amplify or modify in some way the resonance. This body, which vibrates primarily and in individual cases may even be the only one of

[*] [Schaeffner is here referring to split idiophones with two arms forced apart.]

the whole instrument, seems to be most important to us for the constitution of the timbre proper of the instrument. In the absence of a classification strictly based on timbres – which would have been the only desirable one, but would have had to take into account all modifications of the timbre which are brought about by the practice of changing register, attack and even the volume of the same instrument – we have to admit that among the invariable elements, which determine certain constant qualities of the timbre of an instrument, the primary vibrating body cannot be the object of a debatable interpretation. Resonators, boxes or soundboards, and mutes affect only the quality of a sound which exists independently of them; and due to the fact that the produced variation of the intensity is accompanied by a change in timbre, it is essential to grasp the sound in some way at its visible source. The excitation of the primary body stays the same no matter how this is accomplished and how it is sustained. In a way, the manner in which the sound is evoked and the means by which it is amplified both mutually reflect the insurmountable fact of the original vibration. However, while the manner of sound excitation runs the risk of being difficult to interpret, the likewise physical evidence of the means invoked to prolong the sound will better permit us to expand in this direction the field of classification by vibrating materials.

The physical designation of all these materials, aside from not giving rise to any lack of clarity, turns our attention to a kind of *tinkling* which is inherent in each body and to which the primitives have shown to be sensible. While the forms of the instruments were often given by the nature of the objects, and while the procedure of vibration had to comply as much as possible with the conditions of the construction, the choice of materials and the pleasure produced by its tinkling illuminates infinitely more about the musical mentality of an indigene, i.e., about the psychology of primitive art. Here, organology and aesthetics closely touch. In the choice of a material, all of an indigene's surprise about and attention toward the marvelous rustling can be detected toward the singular sound quality of the body he handles. Here, especially, the unbelievable subtlety of certain primitive or infant instruments and such subtlety's intimate sonority – which is not even reached by the ancient clavichord – are presented: a subtle presence [French "lancinement", lit. "twinge"] of notes, of minute timbres, elates the individual's hearing. Thus, one can better grasp man's immense musical needs and the habitual enlightenment which the least sounds evoke in him.

Based on the choice of vibrating materials, a geographic distribution of instruments could underscore the relationships which exist between them and the other objects of the same zone of material culture ["civilization"]: metallophones and certain rattles appear where metal working and braiding are practiced; rattling devices made of shells or fruit skin are linked to the harvest of produce from the coast or soil. In

a classification based on the quality of timbre, which is inherent to each body, employed, psychology and technology will find a common terrain of analysis and – we believe – a most fertile one. In this particular domain, as in many others, musical aesthetics have existed sufficiently distant from precise technical data to find new inspiration among them from now on. In its own fantasies it will substitute the meticulous study of sensory fantasies in which the music of primitives indulged itself – a study which so far only an ethnology liberated from European prejudices was willing to undertake. Among the peoples who do not possess music "worthy to be called as such", aesthetics, if not criticism, could search for the secret of a prudent objectivity, which several centuries of musical evolution do not seem to have yet uncovered.

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First, it seems to us that all musical instruments without exception can be grouped into two main categories: instruments where the primary vibrating body is solid, and those where the primary vibrating body is a gas – in the present case, air. The former includes string and percussion instruments (i.e., chordophones, membranophones, and idiophones), and the latter includes wind instruments (i.e., aerophones). Does not a comparable division reflect two essential and distinct human gestures, i.e., those touching or beating a body, and those blowing into a cavity? These are two natural gestures whose prototypes are to be found in song and hand clapping or the beating of any other part of the body – thigh, shoulder, foot on the ground, etc. Both the Arab theorist Al Farabi and Victor Mahillon have noted this fundamental division from which they could derive the principle of the present classification of musical instruments.[25] Even there a place is reserved for a third category if an instrument were to be developed that could set a liquid in motion – e.g., water. However, this would be under the premise of course that it were the water and not – as in certain duck calls (whistles) or whistling pots – the air contained in a tube whose dimensions vary with the liquid's agitation. Incidentally this

[25] Al Farabi, *loc. cit.*: "The thrusting organ is either the human hand or the respirator which repulses the air from inside the chest out of the mouth. The hand beats itself or by means of an external body. The respirators repressing the air produce a kind of thrust. In the first case these are lute and zither instruments, in the second case wind instruments such as flutes and the larynx, the vocal tract." Mahillon, *op. cit.*: "All elastic bodies, be they solid, liquid or gaseous, can produce sounds. But instrument making has necessarily limited the choice of its materials to those where the vibrational movement can be triggered most easily. Among the solid ones, the manufacturing uses strings, membranes, wood, glass, metals, stone, etc.; among the gases, air".

leads us to specify that regarding a solid body or air which originally vibrates, it can well be assumed that this solid body vibrates in ambient air or that this primary air moves within a tube – which itself constitutes a solid body. Emphasis is only on the material which vibrates initially and not on that which supports or contains it or vibrates sympathetically.

I. Musical instruments with solid vibrating bodies

These instruments can be grouped according to whether or not the respective solid body is susceptible to tension. This is not a matter of a dilatation which in the case of metal, for instance, provokes a rise of its temperature. But musical instruments exist whose principle rests on their vibrating bodies not being extensible, while others, in contrast, depend on their state of tension – about in the same way as wind instruments have the gas condition of air which vibrates as their basis. While a xylophone is composed of non-extensible wooden plaques, a violin or kettledrums "involve" [lit. "montent"] strings or tensioned skins. Thus, we immediately recognize that the wooden plaque of a xylophone can produce only one, and always the same, single tone, while the skin of the kettledrum or the string of the violin vary their intonation depending on the degree of their tension. Whether modifiable during execution, or by the performance of the musician, this variable intonation forms the complete object of instruments with strings or membranes. It is opposed to the fixed, sometimes indeterminate, but somehow inert, intonation of bodies on which musical practice in no way exerts tension. It seems to us that here again we come across an essential opposition of two organological principles: on the one hand, it is a matter of tightening an extendible material on some frame, of making it able to sound due to that tension; on the other hand, sole intonations are accommodated which are produced by bodies left to themselves. In both cases, however, the search for "suitable" and *a priori* determined intonations lends itself to be equally possible: without a variable tension of the bodies, their differences in volume, be they given or obtained, produce the range of desirable sounds. But while the extensible bodies easily regain their original form, the others change their intonation only by actually removing or adding material.

A. *Vibration of a solid body, not susceptible to tension, and with invariable or indeterminable intonation.*[26]

The non-tensioned bodies are classified according to their material: *stone, shell, bone, wood, clay, metal, glass*, or any material as yet unforeseeable.

To illustrate this classification, we here present a list of musical instruments. All are in regard to the aforementioned materials and given as simple examples. Without wishing to be exhaustive, it permits underlining the diversity of this type.

STONE (can be struck directly or against another piece of stone).
= stone chime (lithophone)

SHELL (excited by striking directly or against another piece of shell).
= necklace, bracelet, belt or anklet of shells; cymbals of bivalve shells.

BONE (struck directly, by shaking, or scraped).
= jaw of ruminant, carapace of a turtle filled with shells; Mexican *omičikawastli.*

WOOD (struck directly, against another piece of wood or by shaking, grated, scraped, plucked or rubbed).
= plank (stomped, pushed or beaten); slit drum (from the Mexican *teponastli* with two tones to the huge instruments with differently tuned tongues of the Ivory Coast, the Cameroons or Assam[27]); set of plaques or xylophone (African *calafo* [sic! read: *balafo*], South American *marimba*, Javanese *gambang*: with or without individual resonator for each plaque, or with box resonator[28]).

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[26] Let us remember that by extensible or non-extensible, we of course do not broach accidental phenomena of *detuning* due to differences of temperature or often repeated shocks. According to the book *Verges et plaques, cloches et carillons* [Bars and plaques, bells and carillons] by H. Bouasse (Paris, Delagrave, 1927), we see that we are dealing with pins, tongues, plaques, tubes, and vessels here where the excitation is not accompanied by any change of the average dimensions of the body through bending or extending. The vibrating body remains free at its ends; if not fixed at one, it is displaced from its position of equilibrium and naturally returns to it.

[27] Cf. H. Labouret and A. Schaeffner, in *Bulletin du Musée d'ethnographie du Trocadéro*, no. 2 (July 1931).

[28] The *tuned* resonators suspended under the wooden bars of the *balafo* illustrate perfectly the type of instrument where the original timbre (here of struck wood) is modified by that of the resonator: hence the undefinable sonority, intermediary between that of wood *and that of metal,* which certain *balafo* possess. It is therefore important to note in the subdivisions of this classification whether there are resonators, a box resonator, or neither. A distribution chart accommodating these differences would certainly have some surprise in store for us.

two sticks struck against each other arbitrarily or in time; Burmese *valetkiot*; castanets, wooden cymbals, clapper; necklace, bracelet, belt or anklet of fruit skin.
dry fruit with seeds; bamboo tube, wooden or basket rattle with seeds or pebbles; Javanese *angkloun*.
toothed stick, toothed wheel (ratchet), Portuguese *reque-reque*; Antillian *guiro*; instrument with piston[**]
zanza with rattan keys; wooden Jew's harp.
Melanesian *nounout*.

CLAY (struck directly, shaken, scraped or rubbed).
= clay jingle; vessel containing seeds or pebbles.

METAL (struck directly, against another piece of metal, shaken, plucked or rubbed).
= triangle, tuning fork, set of steel plaques or tongues with or without keyboard (metallophone with box resonator or with or without [individual] resonators, celesta); set of tuning forks with keyboard and hammers (dulcitone or typophone); gong, tam-tam, bell without clapper.
bronze cymbals; necklace, bracelet, belt or ankle bells with metal pellets or jingles, rings, metal castanets.[29]
metal rattle, sistrum, jingle, bell.
zanza, music box, metal Jew's harp.
"iron violin" [French: "violon de fer"; nail violin] (*Nagelgeige*).

GLASS
= set of bottles, crystallophone [glass harmonica] (*glasharmonica*).

In this way a classification based on the material of the primary vibrating body leads to separating instruments which are without a doubt adjacent in form or procedure of excitation, but whose difference of the materials used results in the timbres being likewise different. Between the sanza with rattan keys and that with metal ones, between wooden and metal jingles, between wooden and metal castanets, between xylophones, metallophones, crystallophones, and lithophones, the musician's ear perceives dissimilar qualities of timbre, which are not to be neglected.

[**] [It could not be determined which instrument Schaeffner is referring to here.]
[29] On cymbals, castanets, tam-tams, gongs, cf. H. Bouasse, op. cit., pp. 418-421.

B. *Vibration of a solid body, under tension, with variable intonation.*

Opposite of instruments with solid bodies that are not susceptible to tension are instruments where the originally vibrating body is tensioned. Membranes and strings provide the perfect type of such bodies where intonation varies with tension.[30] But knowing which material the strings or membranes consist of is no longer of concern here: the essential fact resides in the particular behavior granted by the tension itself. It would perhaps be imprudent to imagine a lesser diversity of timbres among the string and membrane instruments; at least it appears to depend on other factors than their rather uniform material. Without a doubt certain nuances of timbre exist between strings made of gut, silk or metal; but the making of string instruments has concerned itself rather little with mounting its instruments with strings of identical material. The presence of a mute suffices to modify the timbre of a violin much more noticeably. If the material here is the pure *string* or *membrane* in their acoustical behavior, the sonority of the instrument also depends on everything that determines its tension, as well as on the way it is pressed onto the soundboard or box resonator, and finally on the form or structure of the latter.[31] What is important on a drum is the membrane, but also what provides tension as well as the tube resonator – with particular form and dimensions – on which it is tensioned. Thus, after having emphasized the term *string* or *membrane*, it is necessary to specify the mode of tension and the element which resists the effect of traction. It is important to know whether the tension of the vibrating body is fixed once and for all or whether it changes according to the musician's discretion – while playing or not. In other words, [it is important to know] whether the frame or the neck over which a string or a membrane is tensioned constitutes the only means of tension, or whether a system of pegs is

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[30] Let us borrow some citations from the book *Cordes et membranes* [Strings and membranes] by Bouasse (Paris, Delagrave, 1926): "The interrelationship of strings and membranes is imposed by the form of the equation … which determines their small movements; bars, plaques, tubes … obey very different laws" (p. 1). "The *string*, in the acousticians' sense, differs from the bar by its flexibility, its minor stiffness" (p. 3). "Membranes are thin blades, with uniform thickness, *perfectly flexible*, tightened on a rigid frame" (p. 426).

[31] Actually – and it will be the same with certain wind instruments – a string instrument such as the violin or the viola does not have one single timbre but several ones related to the different registers of the instrument represented here by the different strings. These timbres themselves vary with the mode and the place of the string's excitation. Cf. in this regard H. Bouasse, *Cordes et membranes*, pp. 139-140.

used to adjust it. In the case of strings, even mobile bridges permit a variable division of the latter.

Besides the membrane and the string, and prior to them, we, therefore, include the strip of bark which is not detached from the bamboo neck but is only forced apart and tensioned by tiny wooden bridges. Because of its long and flat form, the bark would constitute an intermediary type between the membrane and the string.

BARK forced apart and tensioned by wooden bridges.
= dulcimer (*krumba* on the isle of Nias, India, West Africa); *valiha* or natural tube zither; Guinean musical bow of bark with several strings.

MEMBRANE: 1st *fixed* (contracted, glued, tied, pegged, nailed) on skullcap, wooden, clay, metal cylinder: struck directly (tambourine, drum), by shaking (pellets enclosed between two membranes), by air blast or vibration (mirliton, phonograph; excited by a stick piercing the membrane or by pulling the strings attached to the membrane);
2nd *tensioned* by laces or metal rings on wooden cylinder or metal hemisphere (drum, kettledrum).

STRING (of vegetable fiber, animal hair, gut, steel).
1st tensioned by hand, a neck, a frame, a sound board: open string (Hindu monochord; musical bow, bow lute ["pluriarc"] {with several necks}; Chinese harp; concave zither of German East Africa; *kasso* of Senegambia); string over bridges (monochord; Japanese *takigoto*).
2nd tensioned *over* a neck, a frame or a soundboard *by* tuning pegs, without bridges (cymbalum, unfretted clavichord, piano; harpsichord, harp, lyre, zither) or with bridges or fingerboard on the neck (trumpet marine, monochord, guitar, lute, fretted clavichord[32]; violin, Chinese khin, hurdy-gurdy).

II. Musical instruments with vibrating air

While for each of the preceding instruments various modes of excitation could always be applied, instruments with vibrating air do not admit more than one way of exciting the air column for any of their essential types. Encased in a tube or a closed vessel, the vibrating air seems beyond any disturbance; hence derives an extremely simple classification imposed by acoustics and a moderate diversity of

[32] The fretted clavichord [clavicorde *lié*] differs from the unfretted one [clavicorde *libre*] in that the key strikes against the string at the same time as it divides it differently. Our classification ranges from instruments where the musician can modify the string tension in no way at all to instruments where the string is tensioned and divided by one procedure or two simultaneous procedures.

instruments, even over time.[33] Is the air stream, which activates the air in the tube, periodic? Is its periodicity due to a vibrating reed or the musician's lips acting as natural reeds? Consequently we could have grouped the instruments with vibrating air column in two categories: first, the ones which regulate by themselves either the form and the direction of the air reed (*flue* of the flageolet) or the periodicity of this [air] reed (reed of the oboe or the clarinet); second, the ones which leave it to the musician's lips to form the air reed (flute) or to give it a periodic flow (horn, trumpet). We believe indeed that the most profound distinctions are between the *general* timbre of flutes and flageolets (i.e., tubes without reed), that of oboes and clarinets (i.e., tubes with reeds), and finally that of horns and trumpets (i.e., tubes with lip reeds). Between the timbres of a flute and a whistle, for example, one does not perceive anything comparable to what distinguishes the flute from a clarinet or horn.

But the air surrounding us can itself serve as material for friction or for percussion by a moveable object. In this case it is not an air column vibrating in a given cavity, but a vibrating or moving object causing an interruption of the exterior air. Without a doubt it will be difficult sometimes to know whether we are actually faced with a vibrating solid body or vibrating air.[34]

a) Vibration of *ambient air*.
by lash or direct friction of the air (whip; buzzer, bullroarer; humming top, ventilator, siren).
by reed, with or without protective tube (tuning pipe and mouth organ; harmonica; accordion; harmonium).

b) Vibration of an *air column* (tube of reed, bamboo, feather, bone, stone, metal, glass, porcelain, etc.).
tube or vessel *without reed* (whistle; ocarina, flute, pan flute, set of organ flue pipes, flageolet, barrel organ, "ground drum", and thigh slapping).
tube and *natural reeds* by vibrating lips (natural horn, conch, horn, trumpet, trombone).
tube and double *reed* (aulos, tibia, crumhorn, oboe, English horn, bassoon) or single *reed* (clarinet, saxophone, bagpipe).

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[33] "Since the origin – writes H. Bouasse – all the wind instruments present themselves in their modern form; *a history of* [these] *instruments does not exist because there has been no evolution*". (*Instruments à vent*. Vol. I, Paris, Delagrave, 1929. p. 27).

[34] Thus, we could be tempted to group the Jew's harp among the latter instruments. But its small tongue possesses an own tone and timbre independent of any possible action on it on behalf of the surrounding air or the mouth (serving as resonator here).

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Our classification would not be well-grounded if it were not to allow for exceptions. We believe that they are of the type that confirms a rule. They underline the importance of a basis constituted by the material of the vibrating bodies.

Diverging instruments or instruments with complex vibration

1. Variations: *tensioned* metal blade (saw, flex-a-tone);
non-tensioned membrane (piece of leather between the thighs, leather roll stuffed with rice husks, leather pouch filled with gravel and shaken).
2. Complex sonority: accompaniment by other sounds (tambourine with struck membrane and shaken metal disks; Oceanian drum with struck membrane and set of shaken fruit skins, etc.).
the striking object itself emitting own sonority (drum struck with metal brush; Antillian and Central or South American *maraca*).
3. Two vibrating materials (Negro or American drum with both membrane and resonator being struck; Arab *bendir*, etc.).
4. Double instrument (claviorganum [épinette *organisée*]).

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