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AROM, SIMHA: AKSAK – PRINCIPLES AND TYPOLOGY

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Absztrakt

A török "aksak" kifejezés, amely az oszmán zeneelméletben gyökerezik, "sántát", "botladozót" vagy "bicegőt" jelent. Más szóval, szabálytalannak tekintik. Ez egy olyan ritmusrendszert jelöl, amelyben a darabok vagy szekvenciák általában élénk tempóban zajlanak, és egy modul folyamatos ismétlésén alapulnak, amely a bináris és ternáris mennyiségeken alapuló csoportosítások (pl. 2+3, 2+2+3) egymás mellé helyezéséből ered, és amelynek összesített száma leggyakrabban páratlan szám. A szerző az aksak jelenséget kettős, strukturális és kulturális szempontból vizsgálja. Különösen az alábbiakra összpontosít: az aksak mint ritmikus forma meghatározása; a tempó tényező meghatározó szerepének kiemelése az aszimmetrikus jelleg érzékelésében; egy tipológia javaslata; és végül, az autentikus aksak sajátosságai alapján – azaz azok, amelyek prímszámokon alapulnak – annak az elképzelésnek az előterjesztése, hogy a nyugati zene "mértéke" nem rendelkezik önálló léttel, és valójában a ritmikus artikuláció első szintjét képezi.

#aksakritmus #oszmanzene #szabalytalanutemek #binarisesternaris #simhaarom

Abstract

The Turkish term aksak, borrowed from the Ottoman musical theory, means "lame," "stumbling," or "limping." In other words, it is considered irregular. It designates a rhythmic system within which pieces or sequences generally taking place in a lively tempo are based on the uninterrupted reiteration of a module resulting from the juxtaposition of groupings based on binary and ternary quantities (e.g., 2+3, 2+2+3) and whose overall number is most often an odd number. The author considers the aksak phenomenon in its double, structural, and cultural aspects. It focuses in particular on the following: defining the aksak as a rhythmic form; highlighting the determining role played by the tempo factor in the perception of its asymmetrical character; proposing a typology; and finally, based on the characteristics specific to authentic aksak – that is to say those based on prime numbers – putting forward the idea that the "measure" of Western music has no autonomous existence and constitutes, in fact, a first level of rhythmic articulation.

#aksakrhythm #ottomanmusic #irregularbeats #binaryandternary #simhaarom

"Music above all else, and for that we prefer the odd" – Verlaine: *Art Poétique, Jadis et Naguère* (1881)

We know that in Tchaikovsky's Pathétique (1893), the second movement "*Allegro con grazia*" is entirely in 5/4 time, the metronomic movement indicating a score of the quarter note at 144. From 1828, it is less known that in the third Movement "*Larghetto*" of his Sonata in C minor (op. 4), Frédéric Chopin seems to have been the first to use the same type of measure, for which Alfred Cortot (1997) recommends the quarter note at 72.[1] Meanwhile, in Wagner, we find six measures in 5/4 in the second scene of the third act of Tristan (1857-59) whose indication is "*Sehr lebhaft*,"

which is equivalent to vivace (i.e., "lively, lively, alert") – within a constant sequence of bar changes and after an acceleration of four bars. In these three cases, we may ask if there are aksak.

The Turkish term aksak borrowed from the Ottoman musical theory means "lame," "stumbling," and "limping." In other words, it is considered irregular. It designates a rhythmic system within which pieces or sequences generally taking place in a lively tempo are primarily grounded on the uninterrupted reiteration of a module resulting from the juxtaposition of groupings based on binary and ternary quantities (i.e., 2+3, 2+2+3) and whose overall number is most often an odd number. The modalities of this type of juxtaposition determine the structure and articulation of the aksak and delimit its form at the same time. However, not every irregular shape is an aksak. To distinguish the temporal organization of music, which has equal pulsations from that which is asymmetrical, Curt Sachs' musicological terminology has qualified the former as "divisive rhythms" and the latter as "additive rhythms."[2] This dichotomy is confusing because, by definition, a rhythm is neither "additive' nor "divisive." On the other hand, the determination of the metric organization, which underlies, relates to an additive or divisive principle. To qualify rhythm in one way or another, it therefore amounts to characterizing a form not about its intrinsic properties, but according to the mental operation that its apprehension requires. Such an approach also proceeds either by division, multiplication, or addition, which amounts to the same thing relating to fundamental values.

In the article of Jérôme Cler (1994), he rightly raises this question of tempo: The continuous conception of these unequal times seemed linked, especially among the Bulgarians and for Bartók, to the great speed of the pieces analyzed.[3] According to Brăiloiu, if the same phenomenon exists at slow times, "it happens, more than once, that the units are subdivided. This is what made some people take the divisional value as a real unit..."[4] As such, Brăiloiu resolves the apparent contradiction between the two representations (discrete and continuous), of these "rhythms bichronous."[5] A few pages later, he adds: "The bottom line is deciding whether an *aksak* meter remains »*aksak*« at a slow tempo, while we do not perceive a 3/2 ratio."[6] He also inquired: "To the extent that, on the same ("geocultural") territory, the identity [of the *aksak*] is established, are we not required to admit that the category »*aksak*« is a system of rhythmic organization generalizable to all tempo and not necessarily perceptible as "lame rhythm?"[7]

Bartók, speaking of the aksak, emphasizes the always rapid tempo in which it takes place:

"In this rhythm, the value of the denominator of the fraction indicating the measure is extraordinarily small, approximately 300 to 400 beats (MM), and these very small fundamental values are not grouped, within the measurements, into values of the same magnitude; therefore, it is symmetrical."[8]

The aksak phenomenon appears to be the only one in music which presents an interdependence between the parameters which account for its structural properties and the *tempo* variable. As such, it requires some clarification: any musical sequence whose metrical organization is irregular, when performed in a moderate movement, can obviously be divided into isochronous pulsations, which objective time is sufficient to materialize in one way or another (i.e., gesture of the conductor or

hand clapping for example) and which are, in turn, divisible into shorter values. On the other hand, when this same sequence is performed at a fast tempo, the duration which until now separated one pulsation from another can then correspond to that which now separates two short values. However, given the most often asymmetrical grouping of the latter, the pulsation turns to be ineffective. It is the short value that acts as a referential value. It is only because of the change in tempo that the asymmetrical "lame" character becomes perceptible. Therefore, tempo is a relevant criterion for identifying aksak.

It is precisely because of their moderate tempo that we do not necessarily discern this irregularity in the examples borrowed from Chopin and Tchaikovsky, which are not aksaks. If the metronomic movement of the "*Allegro con grazia*" of Tchaikovsky had been at least double (with a quarter note at 288) and triple of Chopin's "*Larghetto*" (the quarter note being at 216 or more), there is no doubt that the "limping" asymmetrical aspect of both would have been immediately perceived. This would have made it possible to qualify them as aksak. In contrast, the passage noted in Tristan, where the quarter note is at least 160, can be felt as an aksak. As a rhythmic system characterized by irregularity, aksak is a common feature of Asia Minor and the Balkans' traditional music. It is found not only in Turkey but also in Greece, Bulgaria (Bartók's "Bulgarian rhythm" was applied to it in 1938),[9] Macedonia, Romania, Maghreb, and in sub-Saharan Africa, particularly in Morocco, Cameroon, Congo, and Namibia. In Europe, it is found in Finland, Norway, and Spain.

In this article, I will focus on the following: defining aksak as an independent rhythmic form (ante of – and not assimilated to – metric in the sense of "measure," as conceived by Western theory of music); highlighting the determining role played by the *tempo* factor in the perception that we can have of the asymmetrical, irregular character of the aksak, given that not every irregular rhythmic form is an aksak; showing that the phenomenon is not "one" – we cannot consider as equivalent an aksak whose global number of values admits a division in equal pulsations and one which, based on a prime number, is irreducible to any division *other than by itself*; proposing a typology of aksak; and finally, based on the particular characteristics of aksak, putting forward the idea that the "measure" of Western music, despite the metrical character attributed to this notion, has no autonomous existence and constitutes, in reality, a first level of rhythmic articulation.

From this perspective, I will consider the *aksak* phenomenon in its structural aspect – as a conceptual system that generates a wide variety of configurations. In this regard, I will not dwell on the ways in which it is materialized, or its relationship to the versification of song lyrics or its relationship to dance.

Literature review

Few studies have been devoted to the phenomenon now known as aksak. It seems to be mentioned for the first time in Vasil Stoïn's work, *Balgarskata narodna muzika*, in *Metrika i ritmika* published in Sofia in 1927 and in Stoïan Djoudjeff's, *Rhythm and measure in Bulgarian popular music*, published in Paris in 1931.[10] In a radio conference delivered on 6 April 1938 and published in

Music of Life, Béla Bartók speaks of "Bulgarian rhythm."[11] We had to wait until 1951 for the article entitled *The aksak rhythm* to appear in the *Revue de Musicologie* written by Constantin Brăiloiu, where the term seems to be used for the first time by a Western musicologist.[12] As Jérôme Cler notes:

"In this text, C. Brăiloiu borrows from the Turkish lexicon an adjective qualifying certain meters codified by Ottoman scholarly theory to make it a noun and a universal category of musicology. 'Aksak' in Turkish simply means 'irregular,' 'which is wrong,' and applies for us to rhythms, which are not based on integer multiples of the fundamental value."[13]

Since then, several works and articles have dealt indirectly with the subject, particularly in the descriptive context of repertoires specific to certain regions notably that of Kremenliev (1952), Swets (1958), and Singer (1974).[14] However, none of them seem to consider *aksak* from its theoretical aspect. Finally, it was again in the *Revue de Musicologie* that Jérôme Cler's article appeared in 1994 entitled "For a theory of aksak", in which, he refers mainly to the fieldwork he conducted in Turkey.[15] In the first edition of the *Grove Dictionary of Music and Musicians* (1980), the aksak is not included in the body of the work. However, we find in the Index mentioning, "Aksak, asymmetrical meter," which, by definition, is a misinterpretation, because in the same dictionary, the term "*Metre*" is defined as "a *regular pulse* made up of beats [emphasis added]," which, as we will see later, the aksak is precisely not. In fact, aksak is absent from virtually all music dictionaries including the *Harvard Dictionary of Music* by eminent musicologist Willy Apel.[16] Only Jacques Siron gives a succinct definition in his *Dictionary of Music Words* published in 2022.[17]

In his article devoted to aksak which is still an authoritative source today, Constantin Brăiloiu highlights what distinguishes this system from Western rhythm:

"It differs from it by its fundamental 'irregularity,' the root cause of which lies in the constant use of two units of duration – short and long – instead of one. Moreover, between these two durations reigns an 'irrational' arithmetic relationship, surprising to us, which gives to the melodies in *aksak* this "lame" (also "hindered," "jumped," or "shaken") character evoked by its name. They are not worth 1/2 or 2 of each other, but 2/3 or 3/2. If the short note is denoted by an eighth note, the long note will be expressed by a dotted eighth note. The *aksak* is therefore an irregular bichronous rhythm. On the other hand, the *aksak*, just like our official rhythm, forms 'measures' of these two values. In other words, elementary binary and ternary groups (except in some problematic Bulgarian melodies) are always repeated from start to finish or, at most, alternate with measures of equal overall duration."[18]

Clearly, these lines are an amalgam between the notion of rhythm and metric. In the first paragraph cited, Brăiloiu considers the aksak as "an irregular bichronous rhythm" while the second presents it as forming a "measure."[19] However, only the divisive nature of the measure allows us to speak of bichrony. The notion of measure, however, only makes sense in written music that constitutes a graphic convention, aiming to facilitate reading. If we disregard the notion of measure and

consider the relationships between the two units of duration (short and long) characterizing the aksak and resulting from the grouping of the elementary values which then form its basis, it appears that the status of the aksak is undeniably that of a *rhythmic form*; although underpinned by a rigorous meter, it is no longer confused, from then on, with "measure," and the ambiguity is also removed. This is why, before considering aksak itself, it does not seem superfluous to briefly outline the reasons for the confusion that has reigned for a very long time between the notions of meter, measure, and rhythm.

Time signature, measure, and rhythm

Measured music, attested from ancient Greece, is found in the Middle Ages under the term *cantus mensuratus* (measured singing). Closer to us, in the era of classical opera, it is sometimes referred to by the Italian expression *tempo giusto*. It is made up of durations whose values are *proportional*, measured music is necessarily based on a time standard, which manifests itself differently depending on the eras and civilizations. Thus, ancient Greek metrics were based on a *primary time*, a unit of minimal, indivisible duration, of which its multiples constituted the *foot* and the *meter*. In the West, this standard is none other than the "beat" of the conductor, a beat whose function is to mark the pulsations. The term "measured," says Rousseau in his *Dictionnaire de Musique*, "corresponds the Italian *tempo* or *a Batuta*."[20]

It is a standard of measurement, which has nothing to do with the term "measure" as it has been used in Western music since the seventeenth century. This last meaning relates, in fact, to musical writing. It designates the assembly of a certain number of basic values arranged in groups and separated from each other by bar lines.

However, it is worth remembering that at the time of Ars Nova, where polyphony, in particular with Philippe de Vitry and Guillaume de Machaut, had reached a very high degree of refinement, the notion of measure, in the sense we understand it today, had not yet appeared. What existed then – and the texts provide proof of this – was a simple time standard, ensuring the synchronism of the various vocal and instrumental parts present and which, simultaneously, indicated the tempo. This element, which prefigures Rousseau's *batuta*, was called *tactus* (literally "touch"). For a long period of its history, European music did this. The use of beat as a measuring standard, evidenced around 1275,[21] remained predominant for four centuries. Even the conductor's "stick" originally had no other function than to mark the *tactus*. From the 17th century, another hierarchical mode of measurement was timidly introduced; it asserted itself thanks to the evolution that musical writing was undergoing during that same period. Indeed, Jacques Chailley specifies that "the mere fact of grouping beats into measures was only possible when the notion of »measure« itself (noted graphically by bars) invaded music theory during the seventeenth century."[22]

As an avatar of a simple graphic convention, this notion has gradually modified the very concept of the temporal organization of music in the West. Thus, the boundaries became blurred between what was metrical and what belonged to the domain of rhythm.

This was followed by a confusion that comes, on the one hand, from the different meanings covered by the term metric; on the other, from the overlapping meaning between metric and rhythm, we saw a due confusion, which is the gradual substitution of the notion of "measure" for that of *tactus*. The bar line and the downbeats it implies are so restrictive that most dictionary definitions relating to the ordering of musical time do not even consider the existence of a rhythm that can be proportional – that is to say measured – without being subject to regular accentuation, which would necessarily coincide with certain beats. Thus, the definition of rhythm practically always refers to that of measure and vice versa under the pretext that one is not conceivable without the other.

The different meanings of the term metric, the confusion between the various metrics, and the different definitions of rhythm concern all musicological terminology both of antiquity and the contemporary period. Moreover, there is practically no study devoted to the problems of rhythm which does not open with a warning about the confusion reigning in this matter. This is already the case in one of the first treatises of the Occident, which dates from the end of the fourth century, the *De Musica of Saint Augustine*. In the dialogue of the *Third Book*, precisely entitled *From rhythm to meter*, the Master encourages his disciple to distinguish the two notions: "These words, he told him, have a very broad meaning for us and we must avoid ambiguities...We must distinguish in language what reality distinguishes."[23]

The term *metric* has at least three different, if not contradictory meanings even in the contemporary period. In the literal sense, it refers to *metrum*, which designates a constant value taken as a standard, about which all durations are determined by multiplication or division. In versification, metric concerns the organization of linguistic sequences in units based on oppositions of quantities (long and short syllables), accents, or tonal heights. Finally, in music, by metric we mean the way of ordering the units of time in a larger frame of reference, a matrix of temporal organization or *measure*, provided with precise indications relating not only to the number of values that appear (2/4 or 4/4 for example) but also to their mode of articulation (3/4 or 6/8). Therefore, the measure is a regular time frame marked by a strong beat opposing one or more weak beats within which the values are hierarchical.

When it comes to rhythm, it would be pointless to try to draw up an inventory of its various meanings as there are so many of them. In *The Rhythmic Structure of Music*, Grosvenor Cooper and Leonard Meyer, considered authorities on the subject, define measure as "a framework for ordering accents and weak beats within which the rhythmic grouping takes place. It constitutes the matrix from which rhythm emerges",[24] while the rhythm "can be defined as how one or more unstressed beats are grouped concerning an accented beat. […] Since a rhythmic group can be understood only when its elements are distinguished from each other, rhythm, as defined above, always implies a correlation between a single, accented beat (strong), and one or two unstressed beats (weak)."[25] These two tautological definitions do not make it possible to distinguish the difference between metric and rhythm. Various definitions of measurement all indicate a hierarchy of times that it groups as one. Thus, for *Riemann Musiklexikon*, its different parts belong to an accentual hierarchy

in which the bar line is the main "fulcrum."[26] In contrast, *Ullstein Lexikon der Musik* says that "the measure is a standard, but at the same time creates rules for accentuation".[27]

We could multiply the examples. Everyone insists that there is no measure without an accent. However, basing the measure on a regular reiteration of accents is, in fact, recognizing a rhythmic character. Originally, as we have seen, the measure only aimed to group a certain number of times derived from what the Middle Ages called *tactus*. "Time is a neutral pulsation, devoid of metrical accentuation," indicates André Souris in the *Encyclopédie de la Musique*.[28] He adds, "Under the name of *tactus*...this unitary time was sufficient to organize the execution of the most complex polyphonies of the Renaissance...The bar lines remained independent of metric accentuation" and concludes by remarking that "the system of measurement having been grafted onto that of *tactus* resulted in serious confusion."[29] To summarize, the use of measure appeared only in the second half of the seventeenth century. More so, when this notion was introduced into the musicological vocabulary, the concomitant idea of a regularly reiterated accent entered with it. From then on, the notions of metric (in the sense of "measure") and rhythm were considered inseparable. This made it impossible to clearly define what is specific to each of them and, by corollary, what distinguishes them. Hence, it resulted in the use of ambiguous terminology that lies at the heart of most confusion in the field of rhythm.

The resulting contradictory interpretations are characterized by an overly general meaning given to several terms whose contours are poorly defined. Therefore, it is necessary to use rigorous and unambiguous vocabulary, which I will now highlight. In measured music, meter and rhythm are in permanent interaction. To account for its modalities, it is necessary to consider the respective status of these two parameters in isolation. Thus, it is essential at this stage to make a fundamental distinction between the meaning of the term metric – as I understand it – and that which is generally given to it in musicological vocabulary, measurement, which is the way of ordering times in a hierarchical frame of reference. The metric is thus an equivalent of the *metrum* mentioned above: the determination about a constant value taken as a standard, of time intervals, obtained either by multiplication or by division, but – and this point is crucial – from which any idea of hierarchy is absent. If we adhere to such a definition, we can immediately pose the following axioms: the metric which concerns the calibration of time in equal quantities or values, and the rhythm, which is the modalities of their grouping.

The grouping of values, which necessarily maintains a strictly proportional relationship with the standard of time, generates a sound structure, somehow delimited, and is therefore perceptible. The metric is quantitative while the rhythm is qualitative. The meter is a continuum while rhythm is a temporal form. To illustrate, we can say that the meter is the silent framework on which the rhythm unfolds. For a sequence of sounds (or a grouping of values) to be perceived as a form, at least one of its constituents must necessarily be marked by a trait that sets it apart from the others.

Three types of marks are likely to make this opposition perceptible: accent, modification of timbre, and alternation of durations. The accent is the opposition materializing by a mark of intensity whose reiteration can be regular or irregular. Modification of timbre, on the one hand, is the opposition

produced by the alternation (regular or irregular) of differentiated timbres, whereas alternation of durations serves as the opposition resulting from the succession of unequal values; in the absence of any mark of intensity and differentiated timbres, the opposition of durations remains the only rhythmic criterion.

Most often associated in practice, the distinction between these three parameters is here for methodological reasons. It aims to expose the three conditions, at least one of which is necessary and sufficient for the emergence of any rhythmic form.[30] This is to the extent that we subscribe to the proposition from which the presence of a contrasting feature conditions the very existence of rhythm. In good logic, it follows the opposite proposition: as soon as there is contrast, there is necessarily rhythm. We must then recognize that the generally accepted definition of "metric" (based on the regular opposition between sounds carrying accents and others that do not) is, in reality, based on criteria whose essence is rhythmic. A form deployed in time is a rhythmic form. By this term, I mean any grouping of sounds that lends itself to delimitation using at least one of the marks mentioned above. Under these conditions, a cell of two sounds, just like the entirety of a symphonic movement, constitute one as well as the other – and even if their respective dimensions differ considerably – a rhythmic form which, to be perceived as such, must necessarily be integrated into a temporal framework which allows its reiteration. This reiteration may or may not coincide with this framework.

In the first case, the form is constituted by a figure delimited by a period, which merges with this framework. In the second case, the figure is part of a necessarily more developed sequence, where it adjoins other rhythmic forms of variable dimensions which are also reiterative. The distribution of all these lends itself to an infinite number of combinations. It follows from the above that repetition implies periodicity. We said above that the grouping of values or sounds, which generates a rhythmic structure, necessarily maintains a proportional relationship with the constant value taken as a standard. However, this relationship manifests differently depending on whether the standard value can be divided or can only be the subject of multiplication. The standard value depends on two factors that are in constant interaction: the metric organization and the tempo. The metric organization can be presented in two aspects: regular or irregular. It is regular when the rhythmic form of the sequence it underlies lends itself to segmentation into isochronous pulsations, divisible in turn into equal units. It is the value of this pulsation which will then serve as a standard. In contrast, it is irregular when, due to its rapid tempo, the rhythmic form is irreducible to such a division; in this case, the standard value necessarily coincides with the fundamental value, which is often the shortest.

What follows are two types of standard: the pulsation (whose design is close to that of the medieval *tactus*) and the fundamental value (the equivalent of *chronos protos*, which is the first time in ancient Greece). We can say that pulsation – this "beat" that Rousseau speaks of – is the cornerstone of metrics, in that it can be the subject of both division and multiplication. It thus constitutes the reference unit for determining the sequences which, regardless of their size, are always multiples. Again, this is the basis of Western "measure." As an organic element of all music based on a

divisive principle, it also constitutes the unit of reference for determining the tempo. The fundamental duration constitutes a minimum operational value[31] (what Mantle Hood called *density referent*), [32] the coinage of which is infrequent. This value, therefore, constitutes the elementary metric unit of which the other values are essentially multiples. This value acts as a standard in music, whose asymmetrical periodicity is irreducible to an equidistant pulsation and whose tempo is too fast to allow a division of the fundamental value.

Typology

Once the relationships between meter, measurement, and rhythm have been clarified, it is possible to return to aksak. This appears in numerous and varied configurations. As such, I propose now the following: (1) to formulate definitions relating to the different types of aksak; (2) to consider the question of translations and permutations and to examine the relationships of the aksak with the melodies which adopt its principle; and (3) to establish the criteria by which an aksak can be combined with one or more.

Aksak is based on a principle of the juxtaposition of rhythmic cells grouping together – according to various arrangements – two and three fundamental values, a principle generating irregular configurations; hence, they present a "lame" character. Let us assume from the outset that all aksak other than the matrix one of five values, based on the combination of two cells (2+3 or 3+2), constitute extensions obtained by addition or intercalation. Thus, an aksak with nine values can only be produced by adding two binary cells to one with five (3+2) + (2+2) (i.e., 3+2+2+2). The formation of an aksak from the latter totaling twelve values can be done either by adding a ternary cell to the one already there (which will give 3+3+2+2+2) or by the intercalation between two binary cells of a ternary cell (3+2+2+3+2). The multiplicity of arrangements to which aksak can give rise requires the establishment of a typology to comprehend it better.

For greater clarity, we will limit at the moment to examining aksak as a structural phenomenon without its cultural dimension (i.e., the way it is conceived and perceived by its users).

From the outset, a distinction is necessary depending on whether the overall number of fundamental values is even or not. In the first case, the aksak presents a symmetrical shape divisible by 2 or 3 – sometimes also by 5 – in equal times and equidistant pulsations. For example, a figure of type 3 3 2 = 8 can be divided by 2 or 4, while a configuration of type 3 2 2 3 2 = 12 is divisible by 2 or 4 as well as by 3 or 6. I qualify them as ***pseudo***-aksaks whose overall number is even. Among the aksaks totaling an odd number of fundamental values, some allow themselves to be reduced into equidistant pulsations, but only according to a ternary principle (2 2 2 3 = 9 just like 3×3 = 9). I consider them ***quasi***-aksaks. Then, there are those based on *prime numbers* – such as 5, 7, 11, 13 – which by definition, can only be divided by themselves.

The matrix aksak establishes the principle of grouping cells comprising binary and ternary quantities totaling 5 (i.e., 2+3 or 3+2), which happens precisely to be a first number, is considered the first matrix. Because it presents no ambiguity of interpretation as to the modalities of a possible

reduction in equal times, such an aksak is irrefutable. This is why it seems to me that it is both legitimate and relevant to qualify any aksak as *authentic* if they resulted from a prime number.

Still, there is the case of coupled aksaks and compound aksaks which correspond to the grouping of two or more aksaks. Again, it is appropriate to subdivide each of these two categories depending on whether the overall number of values of the aksaks, which appear there respectively, is either even or odd number. Paradoxically, the coupling of two authentic aksaks (based on prime numbers) will necessarily give rise to a module whose overall number is an even number. As a result, two authentic aksaks placed next to each other lose their original quality and are transformed into a *pseudo*-aksak. Conversely, when an even aksak happens to be combined with an odd aksak, their coupling will inevitably result in an odd sum. If to the extent that the latter is divisible, on a ternary basis and in equal times, we will then be in the presence of a *quasi*-aksak; if there is resistance to it, we will be dealing with an authentic aksak.

Authentic aksaks

By *authentic* aksak, I mean it as a rhythmic module executed in a fast tempo based on the combination of binary and ternary cells (e.g., 5 = 2+3; 7 = 3+2+2) and whose sum necessarily corresponds to a prime number such as 5, 7, 11, 13, 17, 19, 23 or 29. Due to the interdependence between their irregular character and the rapidity of their tempo, authentic aksaks are irreducible to an isochronous pulsation. However, in a rhythmic form resistant to such a division, the only criterion of temporal organization remains the mode of grouping of values that constitute it. The latter, as we have seen, comes from the rhythm. This is why it is impossible to differentiate the "measure" of an authentic aksak from its rhythmic articulation. The authentic elementary aksaks (those whose number of cells cannot be modified) are 5 (i.e., 2+3) and 7 (i.e., 2+2+3). Indeed, an *aksak* totaling eleven fundamental values can be formed of four cells (in 2 3 3 3) but also of five (in 2 2 2 2 3), while in those whose sum is 5 and 7 values, the number of cells cannot vary. In contrast to authentic aksaks, all others, whether their sum is even or odd, can be subdivided into binary or ternary beats. However, it is important to distinguish them.

Quasi-aksaks

I named those odd numbers of fundamental values (but not a prime number) *quasi*-aksaks. They are characterized by figures with a lively tempo inscribed in a metric framework whose sum of values divisible by 3 is asymmetrical (i.e., 9 = 2+2+2+3, equivalent to 3 x 3). This asymmetry generates a significant coefficient of ambiguity that allows the rhythmic content to be perceived in two different ways either as a true aksak or a rhythmic module inscribed in a metrical framework divisible into three equal beats, but which would be "syncopated." Thus, in the example above, the sequence 2 2 2 which precedes 3 can be perceived with the latter as a hemiola (6 = 3 x 2 but also 2 x 3).

Dave Brubeck, at the beginning of the famous "*Blue Rondo à la Türk*," whose score indicates as metronomic movement 126 on the dotted quarter note (but takes care to specify 378 on the eighth note, which is the fundamental value of this piece), plays precisely on this ambivalence by reiterating three times an aksak of 2+2+2+3 which regularly alternates with a grouping of 3+3+3. [33] The main theme of such a piece is built on the following rhythmic matrix 2 2 2 3–2 2 2 3–2 2 2 3–3 3 3 stated successively 16 times and to be repeated five more times before the end of the piece. The simplest *quasi*-aksak is that of 9 in 2 2 2 3.

Pseudo-aksaks

Due to their symmetrical nature, I call aksaks whose sum is an even number *pseudo*-aksaks. It means a rhythmic form stated in a lively tempo inscribed in a divisible metrical framework and whose sum of constituent values corresponds to an even number (e.g., 8 = 3+3+2, which corresponds to 2×4 or 4× 2). The elementary pseudo-aksaks are 8 in 2 3 3, 10 in 2 2 3 3, and 12 in 2 2 2 3 3.

Translations versus permutations

Any aksak potentially contains as many "ways of being" or configurations as cells, but the configurations are defined precisely by the mode of distribution of the cells that form it. An aksak comprising two cells, one binary and the other ternary (2 and 3), can therefore appear as a 2 followed by a 3 (2+3) or the opposite (3+2). An aksak totaling seven values giving rise to two cells of 2 and one of 3 offers three possibilities: 2+2+3, 2+3+2 and 3+2+2. As we have now understood, these are simple shifts (translations) where the cell that appeared at the head of a given arrangement always became the last of the following arrangement. Considering the cyclical nature inherent in the aksak and its rapid tempo, it does not affect its properties. Also, to simplify, for each aksak mentioned in the following pages, I will only retain one of its possible formulations – each can be the subject of a certain number of translations.

In coupled aksaks, there can only be translation. Only the grouping of several aksaks can be the subject of permutations provided that the sum of each of the grouped aksaks is different. The first one to meet this condition has twenty values, which can be arranged in 5+7+8 (2 3 / 2 2 3 / 2 3 3) but also in 5+8+7 (2 3 / 2 3 3 / 2 2 3). However, the inversion of the sequence 7+8 with that of 8+7 which, in both cases is preceded by 5, no longer constitutes a translation but rather a permutation, because the topology of this aksak is transformed. On the other hand, in an aksak that brings together three elements (that is to say three aksaks) but one of which is repeated – as is the case for that of 17 in 5+5+7 (2 3 / 2 3 / 2 2 3) – the change of position of any of the three only gives rise to one translation.

Melodies, amalgamations, and coinage

Just as in the aksaks performed by a percussive instrument, it is the opposition between the duration of the binary and ternary cells which makes perceptible the "lame" character of the melodies which adopt the principle. Whether played on an instrument or performed by singing, it is common for melodies in aksak to use the coinage of certain cells or their amalgamation. By coinage, it means the materialization of a cell by its fundamental values: 1+1 for a binary cell and 2+1 for a ternary cell. Amalgamation, in contrast, consists of fusing two or even more cells over a longer period. It concerns two cells of the same type – we will then have 4 in 2+2 and 6 in 3+3 – but it can also associate a binary cell with a ternary cell (5 in 2+3 or 3+2). It goes without saying that, in a statement performed by singing, coinage and amalgamations depend on the number of syllables and their respective properties (long or short). However, both constitute only variants that in no way call into question the identity of the aksak, on which the melody is based.

The dimension of the period of an aksak melody – often even that of a phrase – is much larger than that of the aksak which underlies it. Their relationships can be of two orders: in one case, the rhythmic organization of the melody adopts that of the aksak, which it then reproduces tirelessly; in the other, this organization is based on the concatenation of two or more aksaks. In other words, it is a composed aksak reiterated many times as the melody requires. In either case, the overall period of a melody practically always constitutes an integer multiple of the aksak on which it is based.

Combination criteria

To understand the modalities of grouping compound aksaks, it is necessary to define first the criteria under which this organization is carried out. Intended to highlight the multiple resources of the aksak – the extraordinary richness of combinatorics that it offers – they make it possible to situate any aksak, whatever its arrangement, in the class which is theirs based on a rigorous classification. Viewed from this angle, aksaks are divided into several categories depending on whether they are unbreakable or breakable, the latter being able to be coupled or composed.

Unbreakable aksaks

An aksak is *unbreakable* given the following conditions: when a single binary cell alternates with a single ternary cell (this is only the case of 5 in 2+3 or 3+2); when a single binary cell alternates with a series of two or more ternary cells and vice versa (2 2 2 2 3 or 3 3 3 2 for example); and when it is made up of a series of cells of the same type alternating with a series of the other (such as 2 2 2 2 3 3 3 or 3 3 3 3 2 2 2). The reason is that any segmentation between the two series would cause each to lose the characteristic property of the aksak, which is its fundamental irregularity. More concretely, all aksaks not exceeding eleven fundamental values are unbreakable: 5 by 2 3, ~ 7 by 2 2 3, ~ 8 by 2 3 3, ~ 9 by 2 2 2 3, ~ 10 by 2 2 3 3, and ~11 by 2 3 3 3 or 2 2 2 2 3.

Breakable aksaks

Breakable aksaks, on the one hand, must contain at least two disjoint occurrences of a cell of the same time for it to be divisible and differentiated from all the others: in an aksak such as 3 2 2 2 2 3 2 2, it is the disjunction of the two ternary cells which makes it possible to divide it into 3 2 2 2 2 / 3 2 2 or by translation of one notch into 2 2 2 2 3 / 2 2 3. In other words, the segmentation can only be carried out between two cells whose intrinsic value differs. Thus, an aksak totaling 19 values articulated in 2 3 3 2 3 3 3 can be segmented into 2 3 3 / 2 3 3 3; whereas, if its distribution is in 3 2 2 2 2 2 2 2 or even in 2 2 3 3 3 3 3, it does not obey this criterion and, therefore, it is unbreakable. In theory, all are divisible by twelve if they do not deviate from the constraints described in *b* and *c*. An aksak with 23 values distributed in 2 2 2 2 2 2 2 2 2 2 2 3 or 3 3 3 3 3 3 3 2 and another which would be ordered 2 2 2 2 2 2 2 3 3 3 or 3 3 3 3 3 2 2 2 2 remain indivisible. Moreover, an aksak can remain resistant to any segmentation whatever its size. Among the breakable aksaks, we will distinguish those coupled, which result from the conjunction of two unbreakable aksaks, and those composing and encompassing several of them. As part of this study, I will examine all cases that include five to twenty-nine minimum values, a number beyond which aksaks are attested to be rare.

Coupled aksaks

Coupled aksaks are the coupling of two indivisible aksaks (whether authentic, pseudo-, or quasi- and whatever their dimension) that only gives rise to a single translation. It is this trait that distinguishes them from compound aksaks. Only a single aksak can be coupled from 12 in 7+5 (2 2 3/2 3). In this case, it is the union of two elementary aksaks, since the number of their cells cannot be modified. On the other hand, the conjunction of two aksaks, one based on eleven values and the other on thirteen (24 in 11+13) can be the subject of four different distributions – 2 2 2 2 3/2 2 2 2 2 3, 2 2 2 2 3/2 2 3 3 3, 2 3 3 3/2 2 2 2 2 3 and 2 3 3 3/2 2 3 3 3 – but neither of them lends itself to permutation. These two examples show that the coupling of two authentic aksaks based on prime numbers (7+5 in the first and 11+13 in the second) inevitably generates a *pseudo*-aksak: 12 in one case and 24 in the other.

The first authentic coupled aksak has 13 values in 5+8 (2 3 2 3 3). The first *quasi*-aksak, which has 15, allows two arrangements in 5+10 (2 3/2 2 3 3) and 7+8 (2 2 3/2 3 3). Note that each of these couplings only brings together elementary aksaks.

Compound aksaks

Compound aksaks are those made up of at least three unbreakable aksaks. The first compound aksaks are for the authentic ones (that of 17 values in 5+5+7 (2 3/2 3/2 2 3), which presents twice the aksak of 5 and, therefore, does not lend itself to permutation (an authentic aksak made up of three different elements is only possible from 23 in 5+7+11). *Quasi*-aksaks (that of 21 values), however, allow three arrangements: 5+5+11 (which cannot be permuted), 5+7+9, and 5+9+7 whose topology differs. *Pseudo*-aksaks are those containing 18 in 5+5+8 (not permutable) and followed by 20 in 5+7+8 or 5 +8+7.

Principles of permutation

For aksaks totaling from five to twenty-nine fundamental values, there is a relatively limited number of possible permutations. Any aksak composed of three elements of which two are identical does not admit of any permutation. The same goes for those formed by four elements of which three are identical, as well as for aksaks composed of five with four that are identical. It follows that any aksak composed of *n* elements where *n–1* is identical does not admit any permutation. Aksaks composed of four elements, of which only two are identical, offer the same number of arrangements – three. With these similar constraints, 27 allows three types of combinatorics where 22 and 28 present four 23, and 29 conceal three types of combinatorics. An aksak formed of five elements corresponding to two and three iterations of the same arrangements admits two arrangements (the only case listed is that of 29 by 5+5+5+7+7 and 5+5+7+5+7). Aksaks that bring three different elements together present two arrangements: 20 in 5+7+8 and 5+8+7). Therefore, a single permutation 25 is derived. Finally, an aksak based on the presence of four different elements – which is only possible from 29 – offers six permutation possibilities As can be seen, the number of permutations is not large. What makes this particular form of aksak so rich is the diversity of arrangements that each of the groupings allows. Thus, a coupled aksak of 13+14 values offers four different arrangements.

Structural aksaks versus cultural aksaks

Anthropologists, especially Clifford Geertz, insist that culture must be understood as a shared set of systems of meaning and understanding.[34] The ethnomusicologist Mieczyslaw Kolinski, for his part, mentions the existence of “mental patterning” when it comes to meter and rhythm.[35] This implies that the perception of rhythm operates based on a shared code within the same cognitive system. Two examples confirm this with each having in its way. In November 1990, I collected a lullaby in the village of Lokulela in the extreme southwest of Zaire, in Bolia country. The mother held her child against her chest and, tapping her right hand on the top of her left arm, chanted her song with the following asymmetrical rhythmic ostinato 2 2 2 3. This irregular ostinato of nine fundamental values, a *pseudo*-aksak, can just as easily be conceived based on three equidistant pulsations (3x3). Also, to test her reaction, I superimposed these on the mother’s song, which immediately aroused her disapproval, and at the same time and unanimously of all the villagers present. This means that for the members of the Bolia community, this lullaby can only be thought of in the form of an aksak.

Conversely, Anglo-Saxon ethnomusicologists highlight the existence of a pan-African rhythmic pattern called “standard timeline pattern” which is 12 in 2 2 3 2 3 and could be considered as the coupling of two authentic aksaks: 5 (2 3) + 7 (2 2 3). However, in Central Africa where I asked everywhere (without further details) for hand clapping to be superimposed on this figure, the strikes systematically corresponded to grouping the twelve elementary values into four ternary pulsations

(4 2 3). Here, the figure is thought of in terms of overall symmetry and in no way as the juxtaposition of two aksaks. These two examples eloquently illustrate the divergence that can exist between aksaks, considering only its structural aspect and how it is felt in a given cultural context. Any ethnomusicological description of the aksak phenomenon must consider these two aspects.

At the end of this study, the authentic aksak appears as the most condensed temporal form there is, since everything merges there: the form is delimited by a periodic framework whose metric framework merges with its rhythmic articulation.[36] Since it is impossible to mark differently the "measure" of the authentic aksak and its rhythm, it follows that the "measure" absorbed by the latter has no autonomous existence. Only one level of articulation remains, which is of the form itself. Furthermore, this demonstration on the aksak allowed me to determine the status of the measure and dispel the confusion which reigns in the relationships between meter (as it is generally accepted) and rhythm.

As a graphic convention to regulate the arrangement of durations and facilitate reading, the measure constitutes an abstract framework since it is predetermined and empty, which also pre-exists the music. The concept of measurement, however, prefigures one of the attributes of the sound substance that will be inscribed there – that of a regular reiterative mark. As a result, once endowed with substance, the measure constitutes the first level of rhythmic articulation.

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Appendix I

Inventory of aksaks with 5 to 29 fundamental values

This inventory lists in ascending order the characteristics and resources of all aksaks which total between 5 and 29 fundamental values 28, whatever their type (authentic, pseudo-, or quasi-) 29. For each type, we will successively find the unbreakable aksaks (elementary and non-elementary), coupled, and compound ones. The latter two are presented according to the number of combinations they offer – that is to say the number of elements (i.e., aksaks) of which they are formed – and also the number of distributions that each of these elements admits (19 in 5+14, for example, can be distributed either in 2 3 / 2 2 2 2 3 3, or in 2 3 / 2 3 3 3 3). The different distributions of the same arrangement are indicated by the symbol "~". Finally, remember that translations are not taken into account in this inventory.

APPENDICES

On 5 | Authentic

2 3 – Unbreakable Elemental

On 7 | Authentic

2 2 3 – Unbreakable Elemental

On 8 | Pseudo

2 3 3 – Unbreakable Elemental

On 9 | Quasi

2 2 2 3 – Unbreakable Elemental

On 10 | Pseudo

2 2 3 3 – Unbreakable Elemental

On 11 | Authentic

2 2 2 2 3~2 3 3 3–Unbreakable

On 12 | Pseudo

2 2 2 3 3 – Unbreakable Elemental

Coupled 7+5 2 2 3 / 2 3 [made up of 2 authentic aksaks]

On 13 | Authentic

Unbreakable	2 2 2 2 2 3
Coupled	5+8 2 3/2 3 3

On 14 | Pseudo

Unbreakable	2 2 2 2 3 3 ~2 3 3 3 3
Coupled	5+9 2 3/2 2 2 3

On 15 | Quasi

Unbreakable	2 2 2 2 2 2 3~2 2 2 3 3 3
Coupled	
5+10	2 3/2 2 3 3
7+8	2 2 3/2 3 3

On 16 | Pseudo

Unbreakable	2 2 2 2 2 3 3~2 2 3 3 3 3
Coupled	
5+11	2 3 / 2 2 2 2 3 ~ 2 3 / 2 3 3 3 [made up of 2 authentic aksaks]
7+9	2 2 3/2 2 2 3

On 17 | Authentic

Unbreakable	2 2 2 2 2 2 2 3~2 2 2 2 3 3 3~2 3 3 3 3 3
Coupled	
5+12	2 3/2 2 2 3 3
7+10	2 2 3/2 2 3 3

8+9	2 3 3/2 2 2 3
Composed of 3 elements, 2 of which are identical:	
5+5+7	2 3 / 2 3 / 2 2 3 [composed of 3 elements, 2 of which are identical]

On 18 | Pseudo

Unbreakable	2 2 2 2 2 2 3 3~2 2 2 3 3 3 3
Coupled	
5+13	2 3 / 2 2 2 2 2 3 ~ 2 3 / 2 2 3 3 [made up of 2 authentic aksaks]
7+11	2 2 3 / 2 2 2 2 3 ~ 2 2 3 / 2 3 3 3 [made up of 2 authentic aksaks]
8+10	2 3 3/2 2 3 3
Composé de 3 éléments dont 2 sont identiques:	
5+5+8	2 3/2 3/2 3 3

On 19| Authentic

Unbreakable	2 2 2 2 2 2 2 3~2 2 2 2 2 3 3 3~2 2 3 3 3 3 3	
Coupled		
5+14	2 3/2 2 2 2 3 3~2 3/2 3 3 3 3	
7+12	2 2 3/2 2 2 3 3	
8+11	2 3 3/2 2 2 2 3	
9+10	2 2 2 3/2 2 3 3	
Composés de 3 éléments dont 2 sont identiques:		
5+5+9	2 3/2 3/2 2 2 3	

5+7+7	2 3 / 2 2 3 / 2 2 3 [made up of 3 authentic aksaks]

On 20 | Pseudo

Unbreakable	2 2 2 2 2 2 2 3 3~2 2 2 2 3 3 3 3~2 3 3 3 3 3 3
Coupled	
5+15	2 3/2 2 2 2 2 2 3~2 3/2 2 2 3 3 3
7+13	2 2 3 / 2 2 2 2 2 3 ~ 2 2 3 / 2 2 3 3 3 [made up of 2 authentic aksaks]
8+12	2 3 3/2 2 2 3 3
9+11	2 2 2 3/2 2 2 2 3~2 2 2 3/2 3 3 3
Composed of 3 elements, 2 of which are identical	
5+5+10	2 3/2 3/2 2 3 3
Composed of 3 different elements	
5+7+8	2 3/2 2 3/2 3 3
5+8+7	2 3/2 3 3/2 2 3

On 21 | Quasi

Unbreakable	2 2 2 2 2 2 2 2 2 3~2 2 2 2 2 2 3 3 3~2 2 2 3 3 3 3 3
Coupled	
5+16	2 3/2 2 2 2 2 3 3~2 3/2 2 3 3 3 3
7+14	2 2 3/2 2 2 2 3 3~2 2 3/2 3 3 3 3
8+13	2 3 3/2 2 2 2 2 3~2 3 3/2 2 3 3 3
9+12	2 2 2 3/2 2 2 3 3
10+11	2 2 3 3/2 2 2 2 3~2 2 3 3/2 3 3 3

Composed of 3 elements, 2 of which are identical	
5+5+11	2 3 / 2 3 / 2 2 2 2 3 ~ 2 3 / 2 3 / 2 3 3 3 [made up of 3 authentic aksaks]
5+8+8	2 3/2 3 3/2 3 3
Composed of 3 different elements	
5+7+9	2 3/2 2 3/2 2 2 3
5+9+7	2 3/2 2 2 3/2 2 3

On 22 | Pseudo

Unbrerakable	2 2 2 2 2 2 2 2 3 3~2 2 2 2 2 3 3 3 3~2 2 3 3 3 3 3 3
Coupled	
5+17	2 3/2 2 2 2 2 2 2 3~2 3/2 2 2 2 3 3 3~ 2 3 / 2 3 3 3 3 3 [made up of 2 authentic aksaks]
7+15	2 2 3/2 2 2 2 2 2 3~2 2 3/2 2 2 3 3 3
8+14	2 3 3/2 2 2 2 3 3~2 3 3/2 3 3 3 3
9+13	2 2 2 3/2 2 2 2 2 3~2 2 2 3/2 2 3 3 3
10+12	2 2 3 3/2 2 2 3 3
11+11 30	2 2 2 2 3 / 2 3 3 3 [made up of 2 authentic aksaks]
Composed of 3 elements, 2 of which are identical	
5+5+12	2 3/2 3/2 2 2 3 3
7+7+8	2 2 3/2 2 3 /2 3 3
Composed of 3 different elements	
5+7+10	2 3/2 2 3/2 2 3 3
5+10+7	2 3/2 2 3 3/2 2 3

5+8+9	2 3/2 3 3/2 2 2 3
5+9+8	2 3/2 2 2 3/2 3 3
Components of which 4 elements 3 are identical	
5+5+5+7	2 3 / 2 3 / 2 3 / 2 2 3 [made up of 4 authentic aksaks]

On 23 | Authentic

Unbreakable	2 2 2 2 2 2 2 2 2 2 3~2 2 2 2 2 2 2 3 3 3~2 2 2 2 3 3 3 3 3~2 3 3 3 3 3 3 3
Coupled	
5+18	2 3/2 2 2 2 2 2 3 3~2 3/2 2 2 3 3 3 3
7+16	2 2 3/2 2 2 2 2 3 3~2 2 3/2 2 3 3 3 3
8+15	2 3 3/2 2 2 2 2 2 3~2 3 3/2 2 2 3 3 3
9+14	2 2 2 3/2 2 2 2 3 3~2 2 2 3/2 3 3 3 3
10+13	2 2 3 3/2 2 2 2 2 3~2 2 3 3/2 2 3 3 3
11+12	2 2 2 2 3/2 2 2 3 3~2 3 3 3/2 2 2 3 3
5+5+13	2 3 / 2 3 / 2 2 2 2 2 3 ~ 2 3 / 2 3 / 2 2 3 3 3 [made up of 3 authentic aksaks]
5+9+9	2 3/2 2 2 3/2 2 2 3
7+7+9	2 2 3/2 2 3/2 2 2 3
7+8+8	2 2 3/2 3 3/2 3 3
Composed of 3 different elements	
5+7+11	2 3 / 2 2 3 / 2 2 2 2 3 ~ 2 3 / 2 2 3 / 2 3 3 3 [made up of 3 authentic aksaks]

5+11+7	2 3 / 2 2 2 2 3 / 2 2 3 ~ 2 3 / 2 3 3 3 / 2 2 3 [made up of 3 authentic aksaks]
5+8+10	2 3/2 3 3/2 2 3 3
5+10+8	2 3/2 2 3 3/2 3 3
Composed of 4 elements, 3 of which are identical	
5+5+5+8	2 3/2 3/2 3/2 3 3

On 24 | Pseudo

Unbreakable	2 2 2 2 2 2 2 2 2 3 3~2 2 2 2 2 2 3 3 3 3~2 2 2 3 3 3 3 3 3
Coupled	
5+19	2 3/2 2 2 2 2 2 2 2 3~2 3/2 2 2 2 2 3 3 3~ 2 3 / 2 2 3 3 3 3 3 [made up of 2 authentic aksaks]
7+17	2 2 3/2 2 2 2 2 2 2 3~2 2 3/2 2 2 2 3 3 3~ 2 2 3 / 2 3 3 3 3 3 [made up of 2 authentic aksaks]
8+16	2 3 3/2 2 2 2 2 3 3~2 3 3/2 2 3 3 3 3
9+15	2 2 2 3/2 2 2 2 2 2 3~2 2 2 3/2 2 2 3 3 3
10+14	2 2 3 3/2 2 2 2 3 3~2 2 3 3/2 3 3 3 3
11+13	2 2 2 2 3 / 2 2 2 2 2 3 ~ 2 2 2 2 3 / 2 2 3 3 3 ~ 2 3 3 3 /2 2 2 2 2 3 ~ 2 3 3 3 / 2 2 3 3 3 [made up of 2 authentic aksaks]
Composed of 3 elements, 2 of which are identical	
5+5+14	2 3/2 3/2 2 2 2 3 3~2 3/2 3/2 3 3 3 3
7+7+10	2 2 3/2 2 3/2 2 3 3
Composed of 3 different elements:	
5+7+12	2 3/2 2 3/2 2 2 3 3
5+12+7	2 3/2 2 2 3 3/2 2 3

5+8+11	2 3/2 3 3/2 2 2 2 3~2 3/2 3 3/2 3 3 3
5+11+8	2 3/2 2 2 2 3/2 3 3~2 3/2 3 3 3/2 3 3
5+9+10	2 3/2 2 2 3/2 2 3 3
5+10+9	2 3/2 2 3 3/2 2 2 3
7+8+9	2 2 3/2 3 3/2 2 2 3
7+9+8	2 2 3/2 2 2 3/2 3 3
Composed of 4 elements, 3 of which are identical	
5+5+5+9	2 3/2 3/2 3/2 2 2 3
Composed of 4 elements, 2 and 2 of which are identical	
5+5+7+7	2 3 / 2 3 / 2 2 3 / 2 2 3 [made up of 4 authentic aksaks]

On 25 | Quasi

Unbreakable	2 2 2 2 2 2 2 2 2 2 2 3~2 2 2 2 2 2 2 2 3 3 3~2 2 3 3 3 3 3 3 3
Coupled	
5+20	2 3/2 2 2 2 2 2 2 3 3~2 3/2 2 2 2 3 3 3 3~2 3/2 3 3 3 3 3 3
7+18	2 2 3/2 2 2 2 2 2 3 3~2 2 3/2 2 2 3 3 3 3
8+17	2 3 3/2 2 2 2 2 2 2 3~2 3 3/2 2 2 2 3 3 3~2 3 3/2 3 3 3 3 3
9+16	2 2 2 3/2 2 2 2 2 3 3~2 2 2 3/2 2 3 3 3 3
10+15	2 2 3 3/2 2 2 2 2 2 3~2 2 3 3/2 2 2 3 3 3
11+14	2 2 2 2 3/2 2 2 2 3 3~2 2 2 2 3/2 3 3 3 3~2 3 3 3/2 2 2 2 3 3~2 3 3 3/2 3 3 3 3
12+13	2 2 2 3 3/2 2 2 2 2 3~2 2 2 3 3/2 2 3 3 3
Composed of 3 elements, 2 of which are identical	

5+5+15	2 3/2 3/2 2 2 2 2 2 3~2 3/2 3/2 2 2 3 3 3
5+10+10	2 3/2 2 3 3/2 2 3 3
7+7+11	2 2 3/2 2 3/2 2 2 2 3~2 2 3/2 2 3/2 3 3 3 [made up of 3 authentic aksaks]
7+9+9	2 2 3/2 2 2 3/2 2 2 3
8+8+9	2 3 3/2 3 3/2 2 2 3
Composed of 3 different elements	
5+7+13	2 3/2 2 3/2 2 2 2 2 3~2 3/2 2 3/2 2 3 3 3 [made up of 3 authentic aksaks]
5+13+7	2 3/2 2 2 2 2 3/2 2 3~2 3/2 2 3 3 3/2 2 3 [made up of 3 authentic aksaks]
5+8+12	2 3/2 3 3/2 2 2 3 3
5+12+8	2 3/2 2 2 3 3/2 3 3
5+9+11	2 3/2 2 2 3/2 2 2 2 3~2 3/2 2 23/2 3 3 3
5+11+9	2 3/2 2 2 2 3/2 2 2 3~2 3/2 3 3 3/2 2 2 3
7+8+10	2 2 3/2 3 3/2 2 3 3
7+10+8	2 2 3/2 2 3 3/2 3 3
Composed of 4 elements, 3 of which are identical	
5+5+5+10	2 3/2 3/2 3/2 2 3 3
Composed of 4 elements, 2 of which are identical	
5+5+7+8	2 3/2 3/2 2 3/2 3 3
5+5+8+7	2 3/2 3/2 3 3/2 2 3
5+7+5+8	2 3/2 2 3/2 3/2 3 3

On 26 | Pseudo

Unbreakable	2 2 2 2 2 2 2 2 2 2 3 3~2 2 2 2 2 2 2 3 3 3 3~2 2 2 2 3 3 3 3 3 3~2 3 3 3 3 3 3 3 3
Coupled	
5+21	2 3/2 2 2 2 2 2 2 2 2 3~2 3/2 2 2 2 2 2 3 3 3~2 3/2 2 2 3 3 3 3 3
7+19	2 2 3/2 2 2 2 2 2 2 2 3~2 2 3/2 2 2 2 2 3 3 3~2 2 3/2 2 3 3 3 3 3 [made up of 2 authentic aksaks]
8+18	2 3 3/2 2 2 2 2 2 3 3~2 3 3/2 2 2 3 3 3 3
9+17	2 2 2 3/2 2 2 2 2 2 2 3~2 2 2 3/2 2 2 2 3 3 3~2 2 2 3/2 3 3 3 3 3
10+16	2 2 3 3/2 2 2 2 2 3 3~2 2 3 3/2 2 3 3 3 3
11+15	2 2 2 2 3/2 2 2 2 2 2 3~2 2 2 2 3/2 2 2 3 3 3 2 3 3 3/2 2 2 2 2 2 3~2 3 3 3/2 2 2 3 3
12+14	2 2 2 3 3/2 2 2 2 3 3~2 2 2 3 3/2 3 3 3 3
13+13	2 2 2 2 2 3 / 2 2 3 3 3 [made up of 2 authentic aksaks]
Composed of 3 elements, 2 of which are identical	
5+5+16	2 3/2 3/2 2 2 2 2 3 3~2 3/2 3/2 2 3 3 3 3
7+7+12	2 2 3/2 2 3/2 2 2 3 3
8+8+10	2 3 3/2 3 3/2 2 3 3
8+9+9	2 3 3/2 2 2 3/2 2 2 3
Composed of 3 different elements	
5+7+14	2 3/2 2 3/2 2 2 2 3 3~2 3/2 2 3/2 3 3 3 3
5+14+7	2 3/2 2 2 2 3 3/2 2 3~2 3/2 3 3 3 3/2 2 3
5+8+13	2 3/2 3 3/2 2 2 2 2 3~2 3/2 3 3/2 2 3 3 3
5+13+8	2 3/2 2 2 2 2 3/2 3 3~2 3/2 2 3 3 3/2 3 3

5+9+12	2 3/2 2 2 3/2 2 2 3 3
5+12+9	2 3/2 2 2 3 3/2 2 2 3
5+10+11	2 3 / 2 2 3 3 / 2 2 2 2 3 ~ 2 3 /2 2 3 3 / 2 3 3 3
5+11+10	2 3/2 2 2 2 3/2 2 3 3~2 3/2 3 3 3/2 2 3 3
7+8+11	2 2 3/2 3 3/2 2 2 2 3~2 2 3/2 3 3/2 3 3 3
7+11+8	2 2 3/2 2 2 2 3/2 3 3~2 2 3/2 3 3 3/2 3 3
7+9+10	2 2 3/2 2 2 3/2 2 3 3
7+10+9	2 2 3 / 2 2 3 3 /2 2 2 3
Composed of 4 elements, 3 of which are identical	
5+5+5+11	2 3/2 3/2 3/2 2 2 2 3~2 3/2 3/2 3/2 3 3 3 [made up of 4 authentic aksaks]
5+7+7+7	2 3 / 2 2 3 / 2 2 3 / 2 2 3 [made up of 4 authentic aksaks]
Composed of 4 elements, 2 of which are identical	
5+5+7+9	2 3/2 3/2 2 3/2 2 2 3
5+5+9+7	2 3/2 3/2 2 2 3/2 2 3
5+7+5+9	2 3/2 2 3/2 3/2 2 2 3
Components 4 elements 2 *and* 2 are identical	
5+5+8+8	2 3/2 3/2 3 3/2 3 3

On 27 | Quasi

Unbreakable	2 2 2 2 2 2 2 2 2 2 2 2 3~2 2 2 2 2 2 2 2 2 3 3 3~2 2 2 2 2 2 3 3 3 3~ 2 2 2 3 3 3 3 3 3 3
Coupled	

5+22	2 3/2 2 2 2 2 2 2 2 3 3~2 3/2 2 2 2 2 3 3 3 3~2 3/2 2 3 3 3 3 3 3
7+20	2 2 3/2 2 2 2 2 2 2 3 3~2 2 3/2 2 2 2 3 3 3 3~2 2 3/2 3 3 3 3 3 3
8+19	2 3 3/2 2 2 2 2 2 2 2 3~2 3 3/2 2 2 2 2 3 3 3~2 3 3/2 2 3 3 3 3 3
9+18	2 2 2 3/2 2 2 2 2 2 3 3~2 2 2 3/2 2 2 3 3 3 3
10+17	2 2 3 3/2 2 2 2 2 2 2 3~2 2 3 3/2 2 2 2 3 3 3~2 2 3 3/2 3 3 3 3 3
11+16	2 2 2 2 3/2 2 2 2 2 3 3~2 2 2 2 3/2 2 3 3 3 3~2 3 3 3/2 2 2 2 2 3 3~2 3 3 3/2 2 3 3 3
12+15	2 2 2 3 3/2 2 2 2 2 2 3~2 2 2 3 3/2 2 2 3 3 3
13+14	2 2 2 2 2 3/2 2 2 2 3 3~2 2 2 2 2 3/2 3 3 3 3~2 2 3 3 3/2 2 2 2 3 3~2 2 3 3 3/2 3 3 3
Composed of 3 elements, 2 of which are identical	
5+5+17	2 3/2 3/2 2 2 2 2 2 2 3~2 3/2 3/2 2 2 2 3 3 3~ 2 3 / 2 3 / 2 3 3 3 3 3 [made up of 3 authentic aksaks]
5+11+11	2 3/2 2 2 2 3/2 2 2 2 3~2 3/2 3 3 3/2 3 3 3 [made up of 3 authentic aksaks]
7+7+13	2 2 3/2 2 3/2 2 2 2 2 3~2 2 3/2 2 3/2 2 3 3 3 [made up of 3 authentic aksaks]
7+10+10	2 2 3/2 2 3 3/2 2 3 3
8+8+11	2 3 3/2 3 3/2 2 2 2 3~2 3 3/2 3 3/2 3 3 3
Composed of 3 elements, 2 of which are similar31	
5+11+11	2 3/2 2 2 2 3/2 3 3 3~2 3/2 3 3 3/2 2 2 2 3 [formé de 3 aksaks authentiques]
Composed of 3 different elements	
5+7+15	2 3/2 2 3/2 2 2 2 2 2 3~2 3/2 2 3/2 2 2 3 3 3
5+15+7	2 3/2 2 2 2 2 2 3/2 2 3~2 3/2 2 2 3 3 3/2 2 3
5+8+14	2 3/2 3 3/2 2 2 2 3 3~2 3/2 3 3/2 3 3 3 3
5+14+8	2 3/2 2 2 2 3 3/2 3 3~2 3/2 3 3 3 3/2 3 3

5+9+13	2 3/2 2 2 3/2 2 2 2 2 3~2 3/2 2 2 3/2 2 3 3 3
5+13+9	2 3/2 2 2 2 2 3/2 2 2 3~2 3/2 2 3 3 3/2 2 2 3
5+10+12	2 3/2 2 3 3/2 2 2 3 3
5+12+10	2 3/2 2 2 3 3/2 2 3 3
7+8+12	2 2 3/2 3 3/2 2 2 3 3
7+12+8	2 2 3/2 2 2 3 3/2 3 3
7+9+11	2 2 3/2 2 2 3/2 2 2 2 3~2 2 3/2 2 2 3/2 3 3 3
7+11+9	2 2 3/2 2 2 2 3/2 2 2 3~2 2 3/2 3 3 3/2 2 2 3
8+9+10	2 3 3/2 2 2 3/2 2 3 3
8+10+9	2 3 3/2 2 3 3/2 2 2 3
Composed of 4 elements, 3 of which are identical	
5+5+5+12	2 3/2 3/2 3/2 2 2 3 3
Composed of 4 elements, 2 of which are identical	
5+5+7+10	2 3/2 3/2 2 3/2 2 3 3
5+5+10+7	2 3/2 3/2 2 3 3/2 2 3
5+7+5+10	2 3/2 2 3/2 3/2 2 3 3
5+5+8+9	2 3/2 3/2 3 3/2 2 2 3
5+5+9+8	2 3/2 3/2 2 2 3/2 3 3
5+8+5+9	2 3/2 3 3/2 3/2 2 2 3
5+7+7+8	2 3/2 2 3/2 2 3/2 3 3
5+7+8+7	2 3/2 2 3/2 3 3/2 2 3

5+8+7+7	2 3/2 3 3/2 2 3/2 2 3
Composed of 5 elements, 4 of which are identical	
5+5+5+5+7	2 3 / 2 3 / 2 3 / 2 3 / 2 2 3 [made up of 5 authentic aksaks]

On 28 | Pseudo

Unbreakable	2 2 2 2 2 2 2 2 2 2 2 3 3~2 2 2 2 2 2 2 2 3 3 3 3~2 2 2 2 2 3 3 3 3 3 3~2 2 3 3 3 3 3
Coupled	
5+23	2 3/2 2 2 2 2 2 2 2 2 2 3~2 3/2 2 2 2 2 2 2 3 3 3 2 3/2 2 2 2 3 3 3 3 3~23/2 3 3 3 3 3 3 3 [made up of 2 authentic aksaks]
7+21	2 2 3/2 2 2 2 2 2 2 2 2 3~2 2 3/2 2 2 2 2 2 3 3 3~2 2 3/2 2 2 3 3 3 3 3
8+20	2 3 3/ 2 2 2 2 2 2 2 3 3~2 3 3/2 2 2 2 3 3 3 3~2 3 3/2 3 3 3 3 3 3
9+19	2 2 2 3/2 2 2 2 2 2 2 2 3~2 2 2 3/2 2 2 2 2 3 3 3~2 2 2 3/2 2 3 3 3 3 3
10+18	2 2 3 3/2 2 2 2 2 2 3 3~2 2 3 3/2 2 2 3 3 3 3
11+17	2 2 2 2 3/2 2 2 2 2 2 2 3~2 2 2 2 3/2 2 2 2 3 3 3~2 2 2 2 3/2 3 3 3 3 3 2 3 3 3/2 2 2 2 2 2 2 3~2 3 3 3/2 2 2 2 3 3 3~2 3 3 3/2 3 3 3 3 3 [made up of 2 authentic aksaks]
12+16	2 2 2 3 3/2 2 2 2 2 3 3~2 2 2 3 3/2 2 3 3 3 3
13+15	2 2 2 2 2 3/2 2 2 2 2 2 3~2 2 2 2 2 3/2 2 2 3 3 3~2 2 3 3 3/2 2 2 2 2 2 3~2 2 3 3 3/2 2
14+14	2 2 2 2 3 3/2 3 3 3 3
Made up of 3 elements, 2 of which are identical	
5+5+18	2 3/2 3/2 2 2 2 2 2 3 3~2 3/2 3/2 2 2 3 3 3 3
7+7+14	2 2 3/2 2 3/2 2 2 2 3 3~2 2 3/2 2 3/2 3 3 3 3
8+8+12	2 3 3/2 3 3/2 2 2 3 3

9+9+10	2 2 2 3/2 2 2 3/2 2 3 3
8+10+10	2 3 3/2 2 3 3/2 2 3 3
Made up of 3 different elements	
5+7+16	2 3/2 2 3/2 2 2 2 2 3 3~2 3/2 2 3/2 2 3 3 3 3
5+16+7	2 3/2 2 2 2 2 3 3/2 2 3~2 3/2 2 3 3 3 3/2 2 3
5+8+15	2 3/2 3 3/2 2 2 2 2 2 3~2 3/2 3 3/2 2 2 3 3 3
5+15+8	2 3/2 2 2 2 2 2 3/2 3 3~2 3/2 2 2 3 3 3/2 3 3
5+9+14	2 3/2 2 2 3/2 2 2 2 3 3~2 3/2 2 2 3/2 3 3 3 3
5+14+9	2 3/2 2 2 2 3 3/2 2 2 3~2 3/2 3 3 3 3/2 2 2 3
5+10+13	2 3/2 2 3 3/2 2 2 2 2 3~2 3/2 2 3 3/2 2 3 3 3
5+13+10	2 3/2 2 2 2 2 3/2 2 3 3~2 3/2 2 3 3 3/2 2 3 3
5+11+12	2 3/2 2 2 2 3/2 2 2 3 3~2 3/2 3 3 3/2 2 2 3 3
5+12+11	2 3/2 2 2 3 3/2 2 2 2 3~2 3/2 2 2 3 3/2 3 3 3
7+8+13	2 2 3/2 3 3/2 2 2 2 2 3~2 2 3/2 3 3/2 2 3 3 3
7+13+8	2 2 3/2 2 2 2 2 3/2 3 3~2 2 3/2 2 3 3 3/2 3 3
7+9+12	2 2 3/2 2 2 3/2 2 2 3 3
7+12+9	2 2 3/2 2 2 3 3/2 2 2 3
7+10+11	2 2 3/2 2 3 3/2 2 2 2 3~2 2 3/2 2 3 3/2 3 3 3
7+11+10	2 2 3/2 2 2 2 3/2 2 3 3~2 2 3/2 3 3 3/2 2 3 3
8 +9 +11	2 3 3/2 2 2 3/2 2 2 2 3~2 3 3/2 2 2 3/2 3 3 3
8+11+9	2 3 3/2 2 2 2 3/2 2 2 3~2 3 3/2 3 3 3/2 2 2 3

Made up of 4 elements, 3 of which are identical	
5+5+5+13	2 3/2 3/2 3/2 2 2 2 2 3~2 3/2 3/2 3/2 2 3 3 3 [formed of 4 authentic aksaks]
Made up of 4 elements, 2 of which are identical	
5+5+7+11	2 3/2 3/2 2 3/2 2 2 2 3~2 3/2 3/2 2 3/2 3 3 3 [formed of 4 authentic aksaks]
5+5+11+7	2 3/2 3/2 2 2 2 3/2 2 3~2 3/2 3/2 3 3 3/2 2 3 [formed of 4 authentic aksaks]
5+11+5+7	2 3/2 2 2 2 3/2 3/2 2 3~2 3/2 3 3 3/2 3/2 2 3 [formed of 4 authentic aksaks]
5+5+8+10	2 3/2 3/2 3 3/2 2 3 3
5+5+10+8	2 3/2 3/2 2 3 3/2 3 3
5+10+5+8	2 3/2 2 3 3/2 3/2 3 3
5+7+7+9	2 3/2 2 3/2 2 3/2 2 2 3
5+7+9+7	2 3/2 2 3/2 2 2 3/2 2 3
5+9+7+7	2 3/2 2 2 3/2 2 3/2 2 3
5+7+8+8	2 3/2 2 3/2 3 3/2 3 3
5+8+8+7	2 3/2 3 3/2 3 3/2 2 3
5+8+7+8	2 3/2 3 3/2 2 3/2 3 3
Made up of 4 elements, 2 and 2 of which are identical	
5+5+9+9	2 3/2 3/2 2 2 3/2 2 2 3
Made up of 5 elements, 4 of which are identical	
5+5+5+5+8	2 3/2 3/2 3/2 3/2 3 3

On 29 | Authentique

Unbreakable	2 2 2 2 2 2 2 2 2 2 2 2 2 3~2 2 2 2 2 2 2 2 2 2 3 3 3~2 2 2 2 2 2 2 3 3 3 3 3~2 2 2 2

	3 3 3 3 3 3 3~2 3 3 3 3 3 3 3 3 3
Coupled	
5+24	2 3/2 2 2 2 2 2 2 2 2 3 3~2 3/2 2 2 2 2 2 3 3 3 3~2 3/2 2 2 3 3 3 3 3 3
7+22	2 2 3/2 2 2 2 2 2 2 2 3 3~2 2 3/2 2 2 2 2 3 3 3 3~2 2 3/2 2 3 3 3 3 3 3
8+21	2 3 3/2 2 2 2 2 2 2 2 2 3~2 3 3/2 2 2 2 2 2 3 3 3~2 3 3/2 2 2 3 3 3 3 3
9+20	2 2 2 3/2 2 2 2 2 2 2 3 3~2 2 2 3/2 2 2 2 3 3 3 3~2 2 2 3/2 3 3 3 3 3 3
10+19	2 2 3 3/2 2 2 2 2 2 2 2 3~2 2 3 3/2 2 2 2 2 3 3 3~2 2 3 3/2 2 3 3 3 3 3
11+18	2 2 2 2 3/2 2 2 2 2 2 3 3~2 2 2 2 3/2 2 2 3 3 3 3~2 3 3 3/2 2 2 2 2 2 3 3~2 3 3 3/2 2
12+17	2 2 2 3 3/2 2 2 2 2 2 2 3~2 2 2 3 3/2 2 2 2 3 3 3~2 2 2 3 3/2 3 3 3 3 3
13+16	2 2 2 2 2 3/2 2 2 2 2 3 3~2 2 2 2 2 3/2 2 3 3 3 3~2 2 3 3 3/2 2 2 2 2 3 3~2 2 3 3 3/2
14+15	2 2 2 2 3 3/2 2 2 2 2 2 3~2 2 2 2 3 3/2 2 2 3 3 3 2 3 3 3 3/2 2 2 2 2 2 3~2 3 3 3 3/2
Made up of 3 elements, 2 of which are identical	
5+5+19	2 3/2 3/2 2 2 2 2 2 2 2 3~2 3/2 3/2 2 2 2 2 3 3 3~ 2 3 / 2 3 / 2 2 3 3 3 3 3 [formé de 3 aksaks authentiques]
5+12+12	2 3/2 2 2 3 3/2 2 2 3 3
7+7+15	2 2 3/2 2 3/2 2 2 2 2 2 3~2 2 3/2 2 3/2 2 2 3 3 3
7+11+11	223/22223/22223~223/2333/2333 [formé de 3 aksaks authentiques]
8+8+13	233/233/222223~233/233/22333
9+9+11	2223/2223/22223~2223/2223/2333
9+10+10	2223/2233/2233
Made up of 3 elements, 2 of which are similar	

7+11+11	223/22223/2333~223/2333/22223
Made up of 3 different elements	
5+7+17 23/223/22222223~23/223/2222333~ 2 3 / 2 2 3 / 2 3 3 3 3 3 [made up of 3 authentic aksaks]	
5+17+7 2 3 / 2 2 2 2 2 2 2 3 / 2 2 3 ~ 2 3 / 2 2 2 2 3 3 3 /2 2 3 ~ 2 3 / 2 3 3 3 3 3 / 2 2 3 [made up of 3 authentic aksaks]	
5+8+16 2 3/2 3 3/2 2 2 2 2 3 3~2 3/2 3 3/2 2 3 3 3 3	
5+16+8 2 3/2 2 2 2 2 3 3/2 3 3~2 3/2 2 3 3 3 3/2 3 3	
5+9+15 2 3/2 2 2 3/2 2 2 2 2 2 3~2 3/2 2 2 3/2 2 2 3 3 3	
5+15+9 2 3/2 2 2 2 2 2 3/2 2 2 3~2 3/2 2 2 3 3 3/2 2 2 3	
5+10+14 2 3/2 2 3 3/2 2 2 2 3 3~2 3/2 2 3 3/2 3 3 3 3	
5+14+10 2 3/2 2 2 2 3 3/2 2 3 3~2 3/2 3 3 3 3/2 2 3 3	
5+11+13 2 3/2 2 2 2 3/2 2 2 2 2 3~2 3/2 2 2 2 3/2 2 3 3 3~2 3/2 3 3 3/2 2 2 2 2 3~2 3/2 3 3 3/2 2 3 3 3 [made up of 3 authentic aksaks]	
5+13+11 2 3/2 2 2 2 2 3/2 2 2 2 3~2 3/2 2 2 2 2 3/2 3 3 3~2 3/2 2 3 3 3/2 2 2 2 3~2 3/2 2 3 3 3/2 3 3 3 [made up of 3 authentic aksaks]	
7+8+14 2 2 3/2 3 3/2 2 2 2 3 3~2 2 3/2 3 3/2 3 3 3 3	
7+14+8 2 2 3/2 2 2 2 3 3/2 3 3~2 2 3/2 3 3 3 3/2 3 3	
7+9+13 2 2 3/2 2 2 3/2 2 2 2 2 3~2 2 3/2 2 2 3/2 2 3 3 3	
7+13+9 2 2 3/2 2 2 2 2 3/2 2 2 3~2 2 3/2 2 3 3 3/2 2 2 3	
7+10+12 2 2 3/2 2 3 3/2 2 2 3 3	
7+12+10 2 2 3/2 2 2 3 3/2 2 3 3	
8+9+12 2 3 3/2 2 2 3/2 2 2 3 3	

8+12+9 2 3 3/2 2 2 3 3/2 2 2 3	
8+10+11 2 3 3/2 2 3 3/2 2 2 2 3~2 3 3/2 2 3 3/2 3 3 3	
8+11+10 2 3 3/2 2 2 2 3/2 2 3 3~2 3 3/2 3 3 3/2 2 3 3	
Made up of 4 elements, 3 of which are identical	
5+5+5+14	2 3/2 3/2 3/2 2 2 2 3 3~2 3/2 3/2 3/2 3 3 3 3
7+7+7+8	2 2 3 / 2 2 3 / 2 2 3 /2 3 3
5+8+8+8	2 3/2 3 3/2 3 3/2 3 3
Made up of 4 elements, 2 of which are identical	
5+5+7+12	2 3/2 3/2 2 3/2 2 2 3 3
5+5+12+7	2 3/2 3/2 2 2 3 3/2 2 3
5+7+5+12	2 3/2 2 3/2 3/2 2 2 3 3
5+5+8+11	2 3/2 3/2 3 3/2 2 2 2 3~2 3/2 3/2 3 3/2 3 3 3
5+5+11+8	2 3/2 3/2 2 2 2 3/2 3 3~2 3/2 3/2 3 3 3/2 3 3
5+11+5+8	2 3/2 2 2 2 3/2 3/2 3 3~2 3/2 3 3 3/2 3/2 3 3
5+5+9+10	2 3/2 3/2 2 2 3/2 2 3 3
5+5+10+9	2 3/2 3/2 2 3 3/2 2 2 3
5+9+5+10	2 3/2 2 2 3/2 3/2 2 3 3
5+7+7+10	2 3/2 2 3/2 2 3/2 2 3 3
5+7+10+7	2 3/2 2 3/2 2 3 3/2 2 3
5+10+7+7	2 3/2 2 3 3/2 2 3/2 2 3
Made up of 4 elements, 2 of which are identical	
5+7+8+9	2 3/2 2 3/2 3 3/2 2 2 3

5+7+9+8	2 3/2 2 3/2 2 2 3/2 3 3
5+8+7+9	2 3/2 3 3/2 2 3/2 2 2 3
5+8+9+7	2 3/2 3 3/2 2 2 3/2 2 3
5+9+7+8	2 3/2 2 2 3/2 2 3/2 3 3
5+9+8+7	2 3/2 2 2 3/2 3 3/2 2 3
Made up of 5 elements, 4 of which are identical	
5+5+5+5+9	2 3/2 3/2 3/2 3/2 2 2 3
Made up of 5 elements of which 3 and 2 are identical	
5+5+5+7+7	2 3 / 2 3 / 2 3 / 2 2 3 / 2 2 3 [made up of 5 authentic aksaks]
5+5+7+5+7	2 3 / 2 3 / 2 2 3 / 2 3 / 2 2 3 [made up of 5 authentic aksaks]

Appendix II

Attested aksaks

Attested *aksaks* are those which I have been able to draw empirically. The list below, far from being exhaustive, is intended only to give the reader easy access to audio illustrations (deliberately on CD only) or published transcriptions. Attested *aksaks* are indicated by the title of the CD and the track numbers on which they appear; for transcriptions, the country of origin of each *aksak* listed is followed in brackets by the name of the author and the year of publication. The *aksaks* are reproduced here in the configurations as they appear on the CDs and in the transcriptions. Translations are continued by "~" (e.g., 2 2 3 2 2~2 2 2 2 3~3 2 2 2).

On 5 Values

CD

in 2 3 - *Greece. Tribute to Tsitsanis*, track 5.

Namibia. Songs of the Bushmen Ju'hoansi, track 19.

Afrique Centrale. Cants Kongo, track 22.

Polyphonies des Twa du Rwanda, tracks 3, 6, 7.

en 3 2 - *Afrique centrale. Chants Kongo*, tracks 1, 14.

Afrique Centrale. Cants Kongo, track 2, 3.

Turkestan. Komuz kirghize et dombra kazakh, track 16.

Norvège. Musique folklorique d'Agder, tracks 4, 13, 14, 16, 17, 29.

Turquie - Musique des Bektachi. Chants des Achik, track 11.

Turquie. Chants sacrés d'Anatolie, tracks 14, 16.

Transcriptions

in 2 3 ~ 3 2 – Bulgaria (Djoudjeff 1931), Macedonia and Greece (Swets 1958).

On 7 Values

CD

in 3 2 2 - *Grèce - Épire. Takoutsia, musiciens de Zagori*, tracks 3, 5. *Greece. Carnaval Songs*, tracks 16, 21.

Turkey. Yayla Music, track 3.

Turkey. Sacred Songs of Anatolia, track 7.

Vocal Music in Crete, track 10.

in 2 2 3 -*Turkestan. Kyrgyz Komuz and Kazakh dombra*, track 18. Greece. Carnaval Songs, track 7.

Musik der Nubier. Nord Sudan, CD I, track 6.

Transcriptions

in 3 2 2 ~ 2 2 3 – Bulgaria (Djoudjeff 1931), Greece (Swets 1958);

~ 2 3 2 Serbia (Swets 1958).

On 8 Values

CD

in 2 3 3 - *Namibia. Chants des Bushmen Ju'hoansi*, tracks 12, 13.

in 3 3 2 - *Grèce. Bouzouki et touberleki*, track 10.

Greece. *Carnaval Songs*, track 18.

Musik der Nubier. Nord Sudan, CD II, track 2.

Transcriptions

in 3 2 3 - Turkey. Sacred Songs of Anatolia, track 8. Transcriptions

in 3 2 3 - Bulgaria (Djoudjeff 1931), Croatia (Swets 1958); ~ 2 3 3 - Bulgaria (Djoudjeff 1931), Macedonia (Swets 1958); ~ 3 3 2 - Greece (Swets 1958), Bulgaria (Djoudjeff 1931).

On 9 Values

CD

in 2 2 2 3 - *Grèce. Hommage à Tsitsanis*, tracks 9, 14.

Turquie. Musique de la Yayla, tracks 4, 5, 7.

in 2 3 2 2 - *Turquie. Musique de la Yayla*, track 10.

Transcriptions
in 2 2 2 3~2 2 3 2 – Bulgaria (Djoudjeff 1931); Serbia(Swets1958); ~2 3 2 2 – Bulgaria (Djoudjeff 1931); Greece (Swets 1958 ~ 3 2 2 2 - Turkey (Swets 1958).

On 10 Values

CD

in 3 3 2 2 - *Cameroun. Flûtes des Monts Mondara*, track 3.

Musique des Bektachi. Chants des Achik, track 9.

in 3 2 2 3 - I*nde – Rajasthan. Musiciens professionnels*, track 7.

Transcriptions
in 3 2 2 3 – Bulgaria (Djoudjeff 1931); Turkey (Swets 1958); ~3 3 2 2~2 2 3 3~2 3 3 2 – Bulgaria (Djoudjeff 1931); Serbia (Swets 1958).

On 11 Values

CD

in 2 2 3 2 2 - *Bulgaria. Musique du pays chope*, tracks 15, 21.

Macedonia. Ayde Mori, tracks 2, 9.

Transcriptions

in 2 2 2 2 3 - Bulgaria (Djudjeff 1931), Serbia (Swets 1958); ~ 2 2 3 2 2 - Bulgaria (Djudjeff 1931), Macedonia (Singer 1974); ~ 3 2 2 2 2 - Bulgaria (Djudjeff 1931), Macedonia (Swets 1958).

in 3 2 3 3 - Serbia (Swets 1958).

On 12 Values

Transcriptions

in 3 2 2 2 3 [unbreakable] – Bulgaria (Djoudjeff 1931), Macedonia (Swets 1958, Singer 1974).

in 2 3 2 2 3~3 2 2 3 2~3 2 3 2 2 – Macedonia (Swets 1958);~2 2 3 2 3 – Yugoslavia (Swets 1958).

On 13 Values

CD

in 2 2 3 3 3 [unbreakable] - *Éthiopie. Musique vocale et instrumentale*, CD 1 - track 6.

in 2 2 3 2 2 2 [unbreakable] - *Bulgaria. Musique du pays chope*, track 6.

Transcriptions

in 2 2 2 2 2 3 [unbreakable] - Bulgaria (Djoudjeff 1931); ~2 3 2 2 2 2 – Bulgaria (Swets 1958);

3 2 3 2 3 ~ 2 3 3 2 3 – Macedonia (Swets 1958);~3 2 2 2 2 2~2 2 2 3 2 2 – Macedonia (Singer 1974).

On 14 Values

Transcriptions

in 2 3 2 2 2 3 – Bulgaria (Djoudjeff 1931), Serbia (Swets1958); ~2 3 2 3 2 2 – Bulgaria (Djoudjeff 1931); 2 2 2 3 2 3 – Bulgaria (Swets 1958, Djoudjeff 1931).

On 15 Values

CD

in 2 2 2 2 3 2 2 [unbreakable] - *Bulgaria. Musique du pays chope*, track 17. Transcriptions

in 3 2 2 3 2 3—Macédoine (Swets1958).

On 16 Values

CD

in 3 2 3 3 2 - *Turkey - Bektachi music. Songs of the Achik*, track 1.

in 3 3 2 3 2 3 - *Capoeira, Samba, Candomblé (Bahia/Brasil)*, track 11.

Transcriptions

in 2 2 3 2 2 2 3 – Yugoslavia (Swets 1958);~2 3 2 2 3 2 2 – Macedonia (Swets 1958).

On 17 Values

Transcriptions
in 2 2 2 2 2 3 [unbreakable] – Bulgaria (Djoudjeff 1931, Swets 1958); ~2 2 2 3 2 2 2 2 – Bulgaria (Djoudjeff 1931).

in 2 3 2 3 2 2 3 – Macedonia (Singer 1974).

On 18 Values

Transcriptions

in 2 2 3 2 2 3 2 2 – Macedonia (Swets 1958, Singer 1974); ~3 2 2 2 2 3 2 2 – Macedonia (Singer1974); ~3 2 2 3 2 2 2 2 – Greece (Swets 1958); ~2 2 3 2 2 2 2 3~2 2 2 2 3 2 2 3 – Bulgaria (Djoudjeff 1931).

in 3 2 3 2 3 2 3 – Bulgaria (Djoudjeff 1931). in 2 3 2 3 2 2 2 2 – Bulgaria (Djoudjeff 1931).

On 19 Values

Transcriptions

in 3 2 2 3 2 2 2 3 – Bulgaria (Djudjeff 1931), Macedonia (Swets 1958).

in 3 2 2 2 3 2 2 3 – Bulgaria (Djudjeff 1931).

in 2 2 3 2 3 2 2 3~2 2 3 2 2 3 2 3 – Bulgaria (Djudjeff 1931).

in 2 2 2 3 2 2 2 2 2 [unbreakable] – Bulgaria (Swets 1958).

in 2 2 2 3 2 3 2 3~2 3 2 3 2 2 2 3 – Bulgaria (Djudjeff 1931).

On 21 Values

Transcriptions
in 2 3 2 3 2 2 2 2 3~2 2 2 2 3 2 3 2 3 – Bulgaria (Djoudjeff 1931).
in 2 2 3 2 3 2 2 2 3~2 2 2 3 2 2 3 2 3 – Bulgaria (Djoudjeff 1931).

On 22 Values

Transcriptions

in 2 2 2 2 2 3 2 2 2 3 – Bulgaria (Djoudjeff 1931).

in 2 2 3 2 3 2 3 2 3~2 3 2 3 2 3 2 2 3 – Bulgaria (Djoudjeff 1931).

On 23 Values

Transcriptions

in 2 2 2 2 2 3 2 3 2 3 – Bulgaria (Djoudjeff 1931).

in 2 2 2 3 2 3 2 2 2 3 – Bulgaria (Djoudjeff 1931); ~2 2 2 3 2 2 2 3 2 3 – Macedonia (Singer 1974).

in 3 2 3 2 3 2 3 2 3 – Bulgaria (Djoudjeff 1931).

On 24 Values

CD

in 2 3 2 3 3 3 2 3 3 – *Zaire La musique des Nande*, track 7.

Transcriptions

in 2 2 2 2 3 2 2 2 2 2 3 – Bulgaria (Djoudjeff 1931).

in 2 2 2 2 3 2 2 2 3 2 2 – Bulgaria (Djoudjeff 1931).

in 2 2 2 3 2 3 2 3 2 3~2 3 2 2 2 3 2 3 2 3 – Bulgaria (Djoudjeff 1931).

in 2 3 2 3 2 3 3 3 3 – Macedonia (Kremenliev 1952).

On 25 Values

Transcription
in 2 2 3 2 3 2 2 2 2 2 3 – Bulgaria (Djoudjeff 1931).

On 26 Values

Transcription
in 2 2 3 2 3 2 3 2 2 2 3 – Bulgaria (Djoudjeff 1931).

On 27 Values

CD

in 3 3 3 3 3 3 2 2 2 [unbreakable] - *Peru. Music of the indigenous communities of Cuzco,* tracks 11 and 14.

Transcription

in 2 2 2 3 2 3 2 2 2 3 2 2 – Bulgaria (Djoudjeff 1931).

On 28 Values

Transcription in 222323232223—Bulgaria (Djoudjeff 1931).

On 29 Values

Transcription

in 2 2 2 3 2 3 2 3 2 3 2 3~2 3 2 3 2 2 2 3 2 3 2 3~2 3 2 2 2 3 2 3 2 3 2 3 – Bulgaria (Djoudjeff 1931).

NOTES

1. I would like to express my sincere thanks to Sonia Jollès and Denis-Constant Martin for their help in formatting this text, to Frank Alvarez-Pereyre for his pertinent comments and to Charlotte Truchet, who kindly checked the dismemberments of the *aksaks* that appear in the appended Inventory.

2. Cortot (1997) notes in this connection: "This piece derives its most obvious originality from the use, totally unusual at the time it was written, of the five-beat rhythm."

3. These are bars 1239 to 1244 of Act 3. In the thirty bars preceding those in 5/4 time, there are eleven changes.

4. This text was republished in 1973 in *Problèmes d'ethnomusicologie* (Geneva, Minkoff Reprints).

5. It should be noted in passing that it no longer appears in the Index of the second edition of this monumental work published in 2001. On the other hand, the latest edition of the equally illustrious *Musik in Geschichte und Gegenwart* (1999) does mention him in the Index, but does not devote an entry to him in its "Sachteil."

6. While V. Stoïn (a Bulgarian composer and folklorist from the turn of the century) considers unequal values with a duration ratio of 3:2 as fundamental values, Bartók groups equal fundamental values into new values – this time unequal. This difference in approach is important. V. Stoïn, speaking of the music of his country, insists on the existence of 'unequal values and not multiple pairs of each other,' whereas Bartók 'breaks down these units of time into equal micro-units: what for V. Stoïn is an unequal 'two-beat' measure, becomes for Bartók a '5-beat' (2+3/16). On the one hand, a conception that puts forward non-segmented units whose ratio of magnitude is irrational; on the other, a count of smaller units, "atoms of time." Brăiloiu, for his part, adopts the continuous conception, defining aksak from the outset by "the constant use of two units of duration – short and long – instead of one" (Brăiloiu 1973: 307; Cler 1994: 183).

7. This section takes large extracts from a text dealing with metrics and rhythm in music (Arom 1992), which I feel are necessary to introduce the particular problem of the aksak phenomenon.

8. Cf. in particular Cooper & Meyer (1960: 8 and 96); Riemann (1967: III, 933); Reinhard (1968: 40); Benary (1973: 16-18, 79, 86 and 88); Herzfeld (1974: 54); *Science de la musique* (1976: I, 5); *The New Grove dictionary*... (1980: XII, 222-23). In this respect, the apogee seems to have been reached by *Musik In Geschichte Und Gegenwart*, which groups "Rhythm, Metric, and Measure" under a single entry (1949-1979: XI, 384-420).

9. Cf. in particular Apel (1946: 639); Chailley (1951: 95); Cooper & Meyer (1960: 1); Benary (1973: 8); Kolinski (1973: 494).

10. This led Willi Apel to open the article "Rhythm" in the Harvard Dictionary of Music with this exclamation: "It would be a hopeless task to attempt to give a definition of rhythm acceptable even to a small minority of musicians and musicographers" (Apel 1947: 639). The ethnomusicologist Mieczyslaw Kolinski (1973: 494) also refers to this dilemma, listing some fifty different meanings

of the word “rhythm.” It is clear that the difficulty in defining rhythm stems essentially from its interaction with meter, a situation that leads Peter Benary to remark – sixteen centuries after Saint Augustine – that “a precise terminological delimitation between metric and rhythmic is still lacking” (Benary 1973: 8).

11. In the conclusion to his article on aksak, Jérôme Cler rightly points out: “All the foregoing has merely served to warn against a theoretical 'unification' around a single concept: the aksak domain is itself made up of several sub-sets, and is itself only one of the modes of arrangement of the function that constructs cycles, i.e. meters, in general” (Cler 1994: 209).

12. To be convinced of this, all you have to do is listen to an authentic *aksak* and materialize its metrical scheme and rhythmic figure in turn. Infallibly, the two will coincide.

13. The other elementary aksaks are those that add up to 8, 9, 10, and 12 fundamental values. 14. Translations are based on the same principle as chord inversions.

14. Traslations are based on the same principle as reversals of a chord.

15. The number of translations to which any formulation can give rise always corresponds to the number of cells it contains - 1.

16. Starting from this number, any *aksak* can therefore be “broken down” into three or more elementary *aksaks* (see the combination criteria below).

17. These are the ones that Jérôme Cler describes – by default – as ‘prime:’ “Among the very large number of meters characterized by a bichrony i.e., associating short durations worth 2 with long durations worth 3, at a relatively fast tempo (the metronome at around 200 for the eighth note), some deserve to be called ‘prime:’ i.e., all the others, at the same tempo, may appear to be a ‘composition’ of one or more ‘prime’ meters” (Cler 1994: 195). To avoid any confusion with prime numbers, I have deliberately not used this term.

18. Their inventory is given in the appendix.

19. This is the case for:

19 | in 5+5+9 and 5+7+7

21 | in 5+5+11

22 | in 5+5+12 and 7+7+8

23 | in 5+5+13, 5+9+9, 7+7+9, 7+8+8

24 | in 5+5+14, 7+7+10

25 | in 5+10+10, 7+9+9 and 8+8+9

26 | in 5+5+16, 7+7+12, 8+8+10, 8+9+9

27 | in 5+5+17, 5+11+11, 7+7+13, 7+10+10, 8+8+11

28 | in 5+5+18, 7+7+14, 8+8+12, 9+9+10

29 | in 7+11+11, 9+9+11, 9+10+10.

20. For the first, these are:

22 | in 5+5+5+7

23 | in 5+5+5+8

24 | in 5+5+5+9

25 | in 5+5+5+10

26 | in 5+5+5+11 and 5+7+7+7

27 | in 5+5+5+12

28 | in 5+5+5+13

29 | in 5+5+5+14.

For the seconds,

27 | in 5+5+5+5+7

28 | in 5+5+5+5+8

29 in 5+5+5+5+9.

21. Thus, 25 - the first of this series - can be grouped into 5+5+7+8, 5+5+8+7 and 5+7+5+8; an aksak with 26 values, into 5+5+7+9, 5+5+9+7, 5+7+5+9.

22. a) 5+5+8+9, 5+5+9+8, 5+8+5+9;

b) 5+5+10+7, 5+5+7+10, 5+7+5+10;

c) 5+7+7+8, 5+8+7+7, 5+7+8+7.

23. a) 5+5+7+11, 5+5+11+7, 5+7+5+11

b) 5+5+8+10, 5+5+10+8, 5+8+5+10,

c) 5+7+8+8, 5+8+8+7, 5+8+7+8,

d) 5+7+7+9, 5+9+7+7, 5+7+9+7.

24. a) 5+5+7+12, 5+5+12+7, 5+12+5+7

b) 5+5+8+11, 5+5+11+8, 5+8+5+11

c) 5+5+9+10, 5+5+10+9, 5+9+5+10.

25. 21 allows one grouping: 5+7+9.

22 allows two: 5+7+10 and 5+8+9.

23 gives the next two: 5+7+11 and 5+8+10.

With 24 you get four: 5+7+12, 5+8+11, 5+9+10, 7+8+9.

With 25, four: 5+8+12, 5+9+11, 7+8+10, 5+7+13.
With 26, six: 5+7+14, 5+8+13, 5+9+12, 5+10+11, 7+8+11, 7+9+10.

With 27, seven: 5+7+15, 5+8+14, 5+9+13, 5+10+12, 7+8+12, 7+9+11, 8+9+10.

With 28, nine: 5+7+16, 5+8+15, 5+9+14, 5+10+13, 5+11+12, 7+8+13, 7+9+12, 7+10+11, 8+9+11.

With 29, ten: 5+7+17, 5+8+16, 5+9+15, 5+10+14, 5+11+13, 7+8+14, 7+9+13, 7+10+12, 8+9+12, 8+10+11.

26. 5+7+8+9, 5+8+9+7, 5+9+8+7, 9+5+8+7, 9 +7+8+5, 9+8+5+7.

27. 2 2 2 2 3 / 2 2 2 2 3 3 ~ 2 2 2 2 2 3 / 2 3 3 3 3 ~ 2 2 3 3 3 / 2 2 2 2 3 3 and 2 2 3 3 3 / 2 3 3 3 3.

28. Only the number 6 is not included, as there is no alternation between a binary cell and a ternary cell.

29. For the sake of beauty, I've chosen to stop at 29 – the prime number – and therefore an authentic *aksak*. Beyond this number, the exponential combinatorics become very cumbersome, and attested *aksaks* become rare (cf. Appendix II: Attested aksaks).

30. The coupling of two elements whose sum is identical is relevant when their arrangements differ – which is the case here (2 2 2 2 3 ~ 2 3 3 3). The same principle is at work in the 13+13 pairing in 2 2 2 2 2 3 ~ 2 2 3 3 3.

31. Here, the 5 is followed by 2 x 11 but the arrangement of each is different.

32. Jérôme Cler was kind enough to send me some sound examples of which I was unaware of. I would like to express my gratitude to him.

33. In sub-Saharan Africa, ‘structural’ *aksaks* of type 12, in 5+7, are common but, as we have seen, they are not thought of as such by the members of the communities who use them. This is why I have not mentioned any CDs or transcriptions of them here. The same is true in Central Africa for the ‘structural’ *aksaks* of 16, in 7+9 (found in particular among the Gbaya of Central Africa) and for those of 24, in 11+13, which seem to be the prerogative of the Aka Pygmies.

About the author

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[3] Jérôme Cler, "Pour une théorie de l'aksak," *Revue de Musicologie* 80, no. 1 (1994).

[4] Constantin Brăiloiu, "Le rythme aksak," in *Problèmes d'ethnomusicologie* (réédition d'un article paru dans la *Revue de Musicologie* XXXIII, 1951: 71-108), ed. Gilbert Rouget (Genève: Minkoff Reprints, 1973), 307-308.

[5] Jérôme Cler, "Pour une théorie de l'aksak," *Revue de Musicologie* 80, no. 1 (1994): 183.

[6] Ibid., 194.

[7] Ibid., 195.

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[21] Jacques Chailley, *40 000 ans de musique: L'homme à la découverte de la musique* (Paris: Plon, 1961), 251.
[22] Ibid., 255.
[23] Augustin, *La musique. De musica libri sex. Introduction, traduction et notes de Guy Fianert et F.-J. Thonnard* (Bruges: Desclée De Brouwer et Cie, 1947), 163.
[24] Grosvenor Cooper and Leonard B. Meyer, *The Rhythmic Structure of Music* (Chicago: The University of Chicago Press, 1960), 96.
[25] Ibid., 6.
[26] Hugo Riemann, ed., *Riemann Musiklexikon* (Mainz: Schott, 3, 1967), 933-934.
[27] Friedrich Herzfeld, *Ullstein Lexikon der Musik* (Frankfurt, Berlin and Wien: Verlag Ullstein, 1974), 541.
[28] André Souris, "Temps," in *Michel* 3, (1961): 787.
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[30] Simha Arom, *Polyphonies et polyrythmies instrumentales d'Afrique Centrale: Structure et Méthodologie* in SELAF, Collection Ethnomusicologie I (Paris, 1985), 330-331.
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