SYNESIS IN ARISTOXENIAN THEORY

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in memoriam Miriam W. Hassell

Music must be conceived by human beings. Although the sounds of music derive immediately from the vibrating string or the column of air, the ordering of these sounds into a melody which moves the listener is a function of the human mind. Conceived by the mind, music speaks to other minds, which recognize in it not merely the sounds of melody but representations of human feelings. And although one can analyze precisely the physical properties of sound and interval or dissect meticulously the anatomy of melody, the affective power of music eludes objective representation. In fact, the more closely music is assimilated to its physical form, the farther is one removed from its source and energy. The recognition of this fact is a fundamental achievement of Aristoxenus, the fourth century B.C. musical theorist. His epochal contribution to the history of ideas consists in a theory of music based on the notion ἡ τῆς μουσικῆς ξύνεσις, construed here to be "musical intuition" or "competence," i.e. an inherent mental capacity comprising one's implicit musical knowledge.[1] Formulated

[1] *LSJ* list σύνεσις (ξύνεσις) as being derived by Plato *Crat.* 412A from συνιέναι (σύνειμι), *come together*; they give the received etymology, however, as συνίημι, *perceive, apprehend.* Apart from its unique occurrence in Hom. *Od.* 10.515, where it denotes "a union of the two loud-sounding rivers," σύνεσις appears regularly with reference to some faculty of the mind; thus, Arist. *EN* 1143A13 (τὸ μανθάνειν λέγεται ξυνιέασι); Plato *Crat.* 411A (φρόνησίς τε καὶ ξύνεσις); Eur. *Her.* 655 (ξύνεσις καὶ σοφία); Pind. *Nem.* 7.60 (σύνεσιν . . . φρενῶν); Thuc. 1.75 (γνώμης ξυνέσεως); Arist. *de An.* 410B3 (ξύνεσις as opposed to ἄγνοια). Its appearance with an objective genitive denoting *intelligence in a thing, sagacity in respect to something*, as in Plato *Crat.* 412C (τῇ τοῦ δικαίου συνέσει), is exemplified in Aristoxenus' construction ἡ τῆς μουσικῆς ξύνεσις, but the latter citation is not included in *LSJ*. The gloss *mother-wit* or *native sagacity* for σύνεσις as, for example, in Thuc. 1.138 (οἰκείᾳ ξυνέσει), is a most telling instance of its reference to an inherent knowledge, the sense in which it is used, I believe, by Aristoxenus.

Of the ten occurrences of ξύνεσις and ξυνίημι in the *Harmonics*, only two are used by on this notion, his theory, transmitted to us in the fragmentary document known as *Harmonics*,[2] represents more than a "descriptive anatomy"[3] of ancient Greek music. It is, beyond this, I believe, an attempt to account for the mental process responsible for the creation

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Aristoxenus in the general sense of "understanding" or "comprehension." H. S. Macran, *The Harmonics of Aristoxenus* (Oxford 1902), accordingly translates *Harm.* 3 (p. 167): "Furthermore, it is essential to a clear comprehension of these points..." [εἰς τὴν τούτων ξύνεσιν] and *Harm.* 16 (p. 176): "When it [a definition] puts him in the way of understanding [εἰς τὸ ξυνιέναι] the thing defined." The other instances of ξύνεσις in Aristoxenus' text clearly refer to some kind of mental activity that is more significant than the English words "understanding" and "comprehension" suggest. That Macran was aware of a complex meaning is apparent from his variety of translations, as, for example: "cognition" (p. 189), "apprehension" (p. 193), "intellectual apprehension" (p. 195), "intellectual process" (p. 195). In this paper I argue that *synesis* for Aristoxenus is musical intuition. Aristoxenus states at one point (*Harm.* 38) that "τὸ ξυνιέναι of melodies consists in the ability to follow with the ear and intellect what is taking place with respect to its every distinction" (my translation). This implies more than mere recognition or superficial understanding of melodic lines; it suggests, rather, a total musical competence. This construction is derived from the notion "linguistic competence," for which see Noam Chomsky, *Aspects of the Theory of Syntax* (MIT Press, Cambridge 1965) 4. The orientation of this paper is in many important respects influenced by the work of Chomsky and modern linguistics.

The following abbreviations are used: Jan = C. von Jan, *Musici scriptores Graeci* (Leipzig 1895); D = L. Deubner, *Iamblichus, De vita Pythagorica* (Leipzig 1937); Düring = I. Düring, *Ptolemy, Harmonica* (Göteborg 1930); Dupuis = J. Dupuis, *Theon of Smyrna, Expositio rerum mathematicarum ad legendum Platonem utilium* (Paris 1892); Hoche = R. Hoche, *Nicomachus, Introductionis arithmeticae libri II* (Leipzig, 1865); Winnington-Ingram = R. P. Winnington-Ingram, *Aristides Quintilianus, De musica* (Leipzig 1963).

[2] The treatise has come down to us in three books designated in most of the MSS by the title, "The Harmonic Elements of Aristoxenus." That it has been compiled from as many as three or four works of the author has been suggested by scholars on the basis of various inconsistencies, repetitions and omissions in its treatment of the subject. The first book defines the scope of harmonics and its subsidiary subjects, the second redefines it, establishing the principles (*archai*) from which its laws are deduced, the third comprises theorems and proofs in the manner of Euclid's *Elements*, breaking off abruptly in the course of examining the species of a fourth. Missing elements of the theory may be deduced from material contained in treatises written centuries later as, for example, Cleonides, *Isagogê Harmonikê* and Gaudentius, *Harmonikê Isagogê*, which purport to transmit Aristoxenian doctrine. It is not certain, however, that these writers have handed down the theory without corruption. Cf. R. P. Winnington-Ingram, *Mode in Ancient Greek Music* (Cambridge 1936) 11. Scholarly opinion on the problem of the work's lack of unity and its probable compilation from a multiplicity of treatises is discussed by Macran (above, note 1) 89–92. More recently the question has been given penetrating analysis by R. da Rios, *Aristoxeni Elementa Harmonica* (Rome 1954) who, in the "Prolegomena" (cvii–cxvii), presents her own well considered throughts (cxvi–cxvii).

[3] I. Henderson, "Ancient Greek Music," *The New Oxford History of Music 1* (*Ancient and Oriental Music*), ed. E. Wellesz (London 1957) 343.

and comprehension of music. The importance of Aristoxenus' theory resides then not primarily in its description of musical phenomena, however crucial for our knowledge of Greek music this may be, but, more fundamentally, in its delineation of the possibilities for such phenomena to occur.

The mental process by which music is conceptualized and translated into sound and performance is represented by Aristoxenus in the a priori notion of musical *synesis* or intuition. In his words (*Harm.* 41):[4]

> for, as a fact, the ultimate factor in every visible activity is the intellectual process [*synesis*]. For this latter is the presiding and determining principle; and as for the hands, voice, mouth or breath—it is an error to suppose that they are very much more than inanimate instruments. And if this intellectual activity [*synesis*] is something hidden deep down in the soul, and is not palpable or apparent to the ordinary man, as the operation of the hand and the like are apparent, we must not on that account alter our views. We shall be sure to miss the truth unless we place the supreme and ultimate, not in the thing determined, but in the activity that determines.

The activity that determines is conceived by Aristoxenus to be ἡ τῆς μουσικῆς ξύνεσις (*Harm.* 33) or musical intuition.

In effect, Aristoxenus' theory of music may be regarded as his answer to the question, What is music? The nature of music, whose deeper meaning the probings of science and empiricism were unable to reveal, was understood by Aristoxenus to be an activity of the human mind. For him, musical thought was a reality, the ultimate cause of the musical art that, objectified through performance, could be understood by other minds. In this respect, Aristoxenus' theory of music may be enlisted as evidence for Aristotle's dictum (*EN* 1140A12–14): "All art is concerned with creation, and to practice an art is to contemplate how to create something that admits of existence or non-existence, and the efficient cause of which is in the maker but not in the thing made." For Aristoxenus the efficient cause of music is a mental faculty, termed by him *synesis*.

The method adopted by Aristoxenus for determining the nature of music was to abstract from musical activity a cognitive system in which

[4] English translations are those of Macran (above, note 1).

the properties of musical thought inherent in the notion of intuition are represented. Although he acknowledged that this faculty of intuition was not itself observable in any direct way, that it was, in fact, "something hidden deep down in the soul," he nonetheless considered it to underly all observed musical activity. In his view, any system that attempted to account for musical phenomena in terms of mathematical theory or empirical researches based on the mechanistic function of instruments was destined to become extraneous to the subject or quite at variance with the phenomena (*Harm.* 32). Since neither pure science nor empirical method could approach the reality of musical intuition, Aristoxenus extended his theory beyond the mere physiology of sound and instruments, arguing that the limited focus of such endeavors could not account for the normal use of music, in that they could not account for musical thought itself. Thus, it became necessary for him to invoke a new principle, one whose essence was a form of mental activity. For this reason his system of Harmonics is qualitatively different from anything that was formulated in terms of mathematical acoustics or empirical research.

I

The epochal discovery which ancient authorities unanimously attribute to Pythagoras of Samos,[5] namely that musical notes depend on numerical proportions, was animated by the desire to convert sense distinctions of pitch and interval into observable form. In striving to establish the physical and mathematical properties of sound, Pythagoras supplanted the unobservable testimony of the ear by something concrete and susceptible of measurement. Music was shown by Pythagoras to be ruled by number; it was to have, as it were, an existence external to its cognition, an existence from which a mathematical system of ratios could be extrapolated and studied independently. The fabulous account of Pythagoras' experiment with the

[5] Cf. A. Delatte, *Études sur la littérature pythagoricienne* (Paris 1915) 259. The discovery of the laws of acoustics was attributed to Pythagoras not only by his disciples but also by scholars who were not members of the Pythagorean school itself. See also J. Burnet, *Early Greek Philosophy* (London 1930) 106–7.

anvil and hammers in the smithy as related by Nicomachus of Gerasa[6] depicts Pythagoras seeking to confirm by visible proof the testimony of his own ear:

> One day he (sc. Pythagoras) was deep in thought and seriously considering whether it could be possible to devise some kind of instrumental aid for the ears which would be firm and unerring, such as the visual sense obtains by means of the compass and the ruler or the surveyor's instrument; or the sense of touch obtains with the balance or measuring device. While thus engaged, he walked by a smithy and, by divine chance, heard the hammers beating out iron on the anvil and mixedly giving off sounds which were most harmonious with one another, except for one combination. He recognized in these sounds the consonance of the octave, the fifth and the fourth. But he perceived that the interval between the fourth and the fifth was dissonant in itself but was otherwise complementary to the greater of these two consonances.

Nicomachus goes on to describe how Pythagoras weighed the hammers and transferred the results of his tests to strings under tension comparable to the hammer weights.[7] Boethius (*De inst. mus.* 1.10–11) also reports the circumstances which enabled Pythagoras to formulate the numerical proportions of the musical consonances. His account, like that of Nicomachus, emphasizes Pythagoras' reluctance to trust the testimony of the auditory sense (*qui nullis humanis auribus credens*), which he believed to be unreliable by nature and susceptible to external factors (*quae partim natura, partim etiam extrinsecus accidentibus permutentur*), or that of musical instruments, which admit of variation under the influence of temperature change or other contingencies. According to

[6] Nicomachus of Gerasa is apparently the earliest writer (*fl.* 120 A.D.) to have transmitted the story, in his *Harmonikon Enchiridion* 6 (Jan 245–46). Other writers, whose accounts of Pythagoras' experiment do not differ essentially from that of Nicomachus, are all considerably later than Nicomachus and may have used him as their primary source. This is unquestionably true of Iamblichus (c250–c325 A.D.) who, in his *De vita Pythagorica* 115–120 (D 66–69), follows Nicomachus almost word for word.

[7] *Harmonikon Enchiridion* 6 (Jan 246–47). Had this experiment been performed with strings of equal length and thickness, as Nicomachus' account has it, it would have been found that the vibrational frequency of the string producing the higher note had risen proportionally with the square root of the tension. Thus, in order to raise the pitch of a string an octave, it would be necessary to quadruple its tension. Burnet (above, note 5) 107 finds the absurdity of Nicomachus' account to be its chief merit in that it bears the stamp of a true popular tale indicative of "the existence of a real tradition that Pythagoras was the author of this momentous discovery." In terms of actual fact, the data given by Nicomachus can only be interpreted on the basis of string lengths.

Boethius, Pythagoras' discovery was preceded by arduous mental effort (*diuque aestuans inquirebat*) and was finally achieved through a divine impulse (*divino quodam motu*). The result of Pythagoras' efforts to translate the phenomena of sound into numbers was the momentous discovery that the numerical ratios productive of the consonant intervals—octave, fifth and fourth—were 2:1, 3:2 and 4:3, respectively. The consonances were thus defined and their numerical definitions were in turn given an objective reality of their own. The underlying principle of *harmonia*, that is, the proper fitting together of pitch elements into the system of the octave,[8] is a numerical system bound together by interlocking ratios externally limited by the octave and internally by the means.[9] The system of ratios—6:8:9:12—whose internal means (arithmetic and harmonic) between the extremes expresses the consonant intervals of the musical scale, was called most perfect by Nicomachus (*Intro. arith.* 2.29.1; Hoche 144) and considered by him worthy of the term *harmonia*. This series—6:8:9:12—yields, of course, the exact proportional value of string lengths representing the consonant intervals of the octave; i.e. 6:12 = 1:2 (octave), 8:12 = 2:3 (fifth), 6:9 = 2:3 (fifth), 6:8 = 3:4 (fourth), 9:12 = 3:4 (fourth).

The tests by which these mathematical facts were demonstrated were extended by Pythagoras to various other instruments. Of all those mentioned by Nicomachus (striking on dishes, auloi, panpipes, triangular harps), the one most favored by Pythagoras for acoustical experiment was the monochord.[10] This may be inferred from the story reported by Aristides Quintilianus in which Pythagoras, as he lay dying, recommended the monochord to his disciples (*De mus.* 3.2; Winnington-Ingram 97):

> Wherefore they say that Pythagoras, as he was departing from this life, advised his companions to study the monochord, explaining that the perfection which exists in music must be comprehended intellectually through numbers rather than sensorily through hearing.

The principle of expressing the divisions of the monochord through number, bequeathed by Pythagoras to his disciples, was the impulse

[8] Cf. E. A. Lippman, *Musical Thought in Ancient Greece* (New York 1964) 1–3.

[9] The means are discussed by F. M. Cornford, "Mysticism and Science in the Pythagorean Tradition," *CQ* 16 (1922) 144–45. A full scale explanation is provided by P. H. Michel, *De Pythagore à Euclide* (Paris 1950) 387–99.

[10] Nicomachus, *Harmonikon Enchiridion* 6 (Jan 248).

from which the tradition of harmonic science was to evolve.[11] Yet the division of the monochord, the focus of Pythagorean inquiry, was enlisted not for the purpose of revealing the nature of musical art. Rather, it became the means to an altogether different end—the elucidation of a structural element of the universe. The perfection that Pythagoras saw in music was, in fact, viewed as the microcosm of a cosmic design. Of the Pythagoreans Aristotle thus observes (*Met.* 985B31–986A2):

> And since they saw further that the properties and ratios of the musical scales are based upon numbers, and that numbers are the first elements of all nature, they assumed the elements of numbers to be the elements of everything and the whole heaven to be a harmony and number.

In short, the aim of the Pythagoreans was to arrive at a musical scale that was theoretically perfect, not as applied to music per se, but as it expressed through ratios construed to be analogues to the parts of the universe and its design their conception of the structural elements of the cosmos.

It is difficult for us today to appreciate the effects produced by Pythagoras' discovery on the intellectual spirit of antiquity, particularly on that of the Pythagoreans. It provided the key to the science of acoustics, the consequences of which were extended by the Pythagoreans to the whole domain of physics, and it became the corner-stone of their philosophy of arithmology. As Burnet has observed,[12] "It is not too much to say that Greek philosophy was henceforward to be dominated by the notion of the perfectly tuned string." Pythagoras having fixed the consonant intervals of the octave in terms of the formula, 6:8:9:12, it remained for his successors to ascertain mathematically the loci of the notes intervening between these fixed pitches. The result was a full scale in the diatonic genus. Philolaus, the contemporary of Socrates, is credited with the division of the tetrachord[13] (that segment of the scale bounded by the consonance, the

[11] Cf. Henderson (above, note 3) 341.

[12] Burnet (above, note 5) 112.

[13] Nicomachus, *Harmonikon Enchiridion* 9 (Jan 252–54). See also, H. Diels and W. Kranz, *Die Fragmente der Vorsokratiker* 1 (Dublin/Zürich 1966) 408–10, *fr.* 6. The authenticity of the more than twenty fragments attributed to Philolaus has been called into question by numerous scholars, the most cogent arguments against them having been advanced by I. Bywater, "On the Fragments Attributed to Philolaus the Pythagorean," *JPh* 1 (1868) 21–53 and E. Frank, *Plato und die sogenannten Pythagoreer*

fourth) into two whole tones and a semi-tone represented in numerical ratios as 9:8, 9:8 and a *leimma*, 256:243, or the interval "left over" after the subtraction of the two whole tones from the fourth (4:3).[14] The octave was then determined by Philolaus to consist of five whole tones and two semi-tones.

In contrast to the mathematical calculations by which Philolaus arrived at these divisions, we have the computations of Archytas who, a generation after Philolaus, calculated the diatonic division of the tetrachord to be two unequal whole tones (9:8 and 8:7) and a semi-tone (28:27). Archytas is credited with the other generic divisions of the tetrachord: chromatic (32:27, 243:224, 28:27) and enharmonic (5:4, 36:35, 28:27).[15] His calculations as well as those of Eratosthenes (third century B.C.) and Didymus (first century B.C.) are preserved by the second century A.D. scientist, Ptolemy. To these computations must be added those of Ptolemy himself.[16] In addition to these important evaluations of intervallic divisions of the generic scales, we possess the tract of Euclid, the *Sectio Canonis*, in which Pythagorean harmonics is given its most complete statement. The tonal system wherein pitch is represented by number is treated as congruent with mathematical principles only, the question of music as an art having been completely superseded by the dictates of mathematical science.[17] The original Pythagorean postulate, thus generalized and refined, presided over the research into harmonic science for centuries. Finally, we have the most elegant statement of the Pythagorean notion of the

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(Tübingen 1962) 263–335. Although the divison of the tetrachord attributed to Philolaus is suspect for the reasons outlined by Frank (pp. 270–71), there is no reason to suppose that Philolaus did not in fact attempt it in accordance with the Pythagorean principles to which he seems otherwise to have adhered (cf. G. S. Kirk and J. E. Raven, *The Presocratic Philosophers* [Cambridge 1969] 312–13). The difficulty here seems to stem from Nicomachus' possible misrepresentation of the facts. This view demands, of course, a closer examination of the problem than can be attempted here.

[14] The procedure is described by Nicomachus, *Excerpta* 2 (Jan 267–71) and Boethius, *De inst. mus.* 3.5.

[15] Ptolemy, *Harm.* 1.13 (Düring 30–31). The ratios represent descending tetrachords.

[16] Ptolemy, *Harm.* 2.14 (Düring 70–74). These computations as compared by Ptolemy with Aristoxenian musical intervals are studied by R. P. Winnington-Ingram, "Aristoxenus and the Intervals of Greek Music," *CQ* 26 (1932) 195–208, who demonstrates certain affinities between Aristoxenus' generic divisions and those of Archytas.

[17] Cf. Lippman (above, note 8) 156.

harmonic structure of the universe in the cosmic scale enunciated by Plato in the *Timaeus*.

The profundity of the Pythagorean construct—6:8:9:12—can scarcely be over-emphasized, for herein was embodied the alleged structural principle of the universe.[18] The discovery, however, that within the very core of this perfectly attuned universe there existed a flaw was as momentous a revelation for mathematical science as the original discovery of string length proportions itself had been earlier. The Pythagorean *harmonia* based on the notion of an intrinsic symmetry in the natural universe and concretized in the formula of interlocking ratios, was, in fact, violated by the inescapable force of the irrationality of musical space. The fact that the ratio 9:8 was unsusceptible of equal division meant that the octave itself could not be divided equally, that there was in fact no mathematical basis for the representation of the semi-tone in rational numbers.[19] That is, the whole tone represented by the ratio 9:8, itself the difference between a fifth and a fourth ($3:2 \div 4:3$), cannot be divided equally without the use of a surd, or $3:2^{\sqrt{2}}$.

The impact of the discovery of incommensurables on mathematical theory was critical; it opened the way for the advances made by such scholars as Theodorus of Cyrene around 400 B.C. and, under his stimulus, Theaetetus, whose theory of irrationality marks him as one of the most original mathematicians of all time.[20] At the same time, the investigations of irrationality in music generated a new branch of applied mathematics—harmonic science. Accepting number as the foundation for the pitch distinctions of musical sounds, and hence for the

[18] This is exemplified in the theory of the "harmony of the spheres." The nature of the tradition and its associated difficulties are examined by J. A. Philip, *Pythagoras and Early Pythagoreanism* (Toronto 1966) 110–133. It was the revelation of the all-pervading character of number in music that quite possibly prompted the Pythagoreans to postulate that all things could be reduced to number. On this same basis they would be led naturally to the idea of the harmony of the spheres, in which the laws of the unknown macrocosm, the heavens, are explained by analogy with those of the known microcosm, music. Cf. Sir Thomas Heath, *Aristarchus of Samos* (Oxford 1913) 46–47, who believes that Pythagoras' discovery led directly to the doctrine of the harmony of the spheres.

[19] The discovery of the irrational element, $\sqrt{2}$, is usually associated with the geometric theorem concerning right-angled triangles, in which it was revealed that the length of the diagonal of such triangles was not uniformly expressible as an integer. In particular, the diagonal of the square was shown to be $\sqrt{2}$ or *alogos*. Cf. Philip (above, note 18) 200.

[20] F. Lasserre, *The Birth of Mathematics in the Age of Plato* (Larchmont 1964) 65–70.

measure of their authenticity and value, the harmonic scientists treated number as the absolute objective reality of music. The systematic confrontation of the musical facts represented by number was for them the sole source of knowledge about music. These investigations, however, committed to mathematical explanations and at the same time faced with the insurmountable difficulties posed by incommensurables, ultimately led, as they must, to musically impractical, i.e. counter-intuitive, results.

For those who taught the practical art of music, those Harmonists against whom Aristoxenus inveighed in his *Harmonics*, the irrationality of musical space was an insupportable difficulty. Properly speaking, the harmonic theorists were concerned with the correct "fitting together" of musical scales. Such scales, constituted of pitch sequences distributed in a proper relationship to one another, could scarcely represent a true *harmonia* if based on an inherent irrationality that required readjustment of all intervals smaller than a whole tone. The problem was faced independently as early as the sixth century B.C. by Lasus of Hermione, the dithyrambic poet, musical theorist and teacher of Pindar, whose solution consisted in assigning the attribute of breadth to musical notes, a notion rejected by Aristoxenus (*Harm.* 3) as useless in determining exactly what a musical note is.[21] Furthermore, we know from Aristoxenus, who cites his predecessors in order to criticise them (*Harm.* 5–7), that the procedure these latter theorists adopted to rid the musical scale of inherent irrationality[22] involved an empirical process of reducing intervals to the smallest possible indivisible quantity, that is, to an atomic interval. This interval would only be appreciated by the ear; it would not necessitate number for its determination since Pythagorean theory would not permit its numerical representation, on the

[21] Lasus' treatise, *De musica*, of which only a few fragments survive, is believed to be the most ancient treatment of the subject. He is reported by Theon of Smyrna *Exp.* 12 (Dupuis 96) to have experimented with the vibratory motions of sound-producing bodies in connection with the calculations of the consonances. For a discussion of his contributions to musical theory, see F. Lasserre, *Plutarque de la musique* (Olten and Lausanne 1954) 34–44. On the question of "breadth" cf. Henderson (above, note 3) 342 and Macran (above, note 1) 226–27.

[22] Aristoxenus does not state explicitly that this was the purpose of the harmonists' empirical procedures. Their aim was in reality more practical than theoretical: to discover an homogeneity in the musical continuum that would render intermodulations possible. Cf. Macran (above, note 1) 230–32 and Henderson (above, note 3) 342 for discussion of this question. See also, F. Lasserre (above, note 20) 175–76.

grounds that so small a fraction on the sound continuum could only be produced by a difference of tension and not by an appreciable difference of string length. Assuming that a musical scale is homogeneous in all its parts and that an interval is a continuous quantity that admitted of increase and decrease by minimal degrees, they endeavored to construct a close-packed system of scales, a *katapyknôsis*, or an arrangement of pitches at the closest possible intervals, and so establish a continuous series of equi-distant sounds separated by the smallest possible intervals (*Harm.* 7). This search for homogeneity in the musical scale is one that persists to this day, the tempered scale currently in use being only one not completely satisfactory solution to the problem of irrationality. Aristoxenus' objection to the empirical procedures of the practical harmonic theorists was fundamentally the same as the one he leveled against the mathematically-minded theorists, namely that the results of empirical techniques had as little relevance for the concerns of musicality as had the mathematical formulations of pitch and interval.[23] First, the nature of the empirical experiments seriously limited the focus of research, to the extent that the enharmonic, that genus admitting of the quarter-tone interval or *diesis* became, within the range of an octave, the sole object of study (*Harm.* 2); secondly, the unbroken series of small intervals postulated by these harmonists was inconsistent with the nature of musicality in that a succession of more than two micro-tones was musically impossible (*Harm.* 28),[24] having existence in mathematical

[23] It might be objected that Aristoxenus' own method of measurement (*Harm.* 25–26) —the division of the whole tone into twelve equal parts with the resultant value of the semi-tone being 6/12, that of the quarter-tone 3/12, etc.—also has no basis in mathematics or empirical results. But the numerical division of the whole tone did not count for Aristoxenus as any solution to the problem posed by incommensurability. As we have seen, the solution for him lay, rather, in shifting the entire theoretical focus away from mathematics and empiricism to the domain of musical competence. His tetrachordal divisions simply enabled him to represent conveniently the various positions that movable notes such as *lichanoi* can occupy within the genera and the *chroai*. Cf. Macran (above, note 1) 248–49 and Winnington-Ingram (above, note 16) 197: "To sum up, we may say that Aristoxenus' primary object is to delimit the spheres of enharmonic, chromatic and diatonic by defining the loci of the movable notes in each . . . He himself reveals that they do not represent all the genuinely melodious divisions, and in particular that equal division of the pycnon is not obligatory."

[24] Diagrams of "condensed" scales comprising a series of twenty-eight quarter-tones were produced by the harmonists, the series constituting an octave and a tone. Their attempts to represent these sequences in notation provoked Aristoxenus' acerbic criticism. Cf. L. Laloy, *Aristoxène de Tarente* (Paris 1904) 114–17.

theory only. Aristotle's concurrence on this point is well taken (*Met.* 1053A14–16): "The unit of measurement is not always 'one' numerically but sometimes is more than one, as is the case with two *dieseis*, which are measured not by ear but by computations." In essence then, *katapyknôsis* was unmelodious and of no practical value in any way (*Harm.* 38). Thus, on the one hand, the work of the mathematical theorists eventually resulted in concerns "utterly extraneous to the subject and quite at variance with the phenomena" (*Harm.* 32); the procedures of the empirically-minded harmonists, on the other, degenerated into the absurdities noted by Plato (*Rep.* 531A–C). It remained for Aristoxenus to redefine the limits of harmonic science in terms of the essential nature of music itself.

II

To accomplish what he considered the task of a musical theory, Aristoxenus reversed the philosophical conceptions of his day, founding a new school of musical thought whose precepts were to become as influential for the study of music as those of Pythagoras himself. As has been summarily outlined in the preceding paragraphs, Greek theorists had been concerned to verify the elements of music through examination of objective data. In this effort they had recourse to empirical methodology or to mathematical physics, neither of which in Aristoxenus' opinion could justly account for music. For Aristoxenus music was primarily a function of the human mind and resided only secondarily or derivatively in actual musical usages. The difference between Aristoxenus' conception and that of the empirical and mathematical theorists is, in fact, one that persists to this day in numerous disciplines quite apart from ancient musicology. To state the matter somewhat oversimply, it is the difference between theories designed to represent primarily certain functions of the mind and thereby to account for the objective data, and those which consist in methods for dealing with the data with the view of arriving by this means at conceptions of mental functions. It is the difference, in other words, between a rationalist and an empiricist theory. The extent to which investigative procedures are rooted in one or the other of these approaches leads to dichotomies observable in disciplines as technically disparate as ancient musicology and, for example, modern psychology, anthropology and linguistics. In ancient Greek music, certainly, the lines are sharply drawn. The significance of Aristoxenus lies in his recognizing that a question of theoretical priorities existed in the approach to music, and in founding a new science using only those materials that belong to music itself—pitch and its apprehension by the human ear. Disavowing the search for logical bridges from experience to theory, he directed himself straight toward basic principles.

Aristoxenus was especially well equipped for his undertaking, having been thoroughly trained in music and philosophy. Born in Tarentum[25] around 360 B.C., he received his earliest instruction in music from his father, Spintharus, a professional musician, as well as from Lamprus of Erythrae.[26] Grounded in music, he benefited also from the circumstance that Magna Graecia was a Pythagorean center, Tarentum itself being the birthplace of Lysis and Archytas.[27] It may be assumed that Aristoxenus was indoctrinated from an early age in Pythagorean thought whether through his father, who probably knew Archytas,[28] or from his having spent his youth in a Pythagorean milieu. It is certain at least that whatever training he received at Tarentum was amplified by formal study at Athens with the Pythagorean Xenophilus of Chalcis.[29] Equipped thus with professional training in music and Pythagorean philosophy, he came finally to the Academy where, as a Peripatetic and student of Aristotle, he was to formulate his theory of music.

Despite unanimous agreement among scholars that Aristoxenus, by virtue of his comparatively early date and the rather considerable remains of his writings, is the foremost technical writer on the music of

[25] All that is known of Aristoxenus' life comes primarily from the account of the Suda s.v. Ἀριστόξενος. Additional references have been collected by F. Wehrli, *Die Schule des Aristoteles* 2 (Basel 1945) *fr.* 1–9. The facts are examined by Laloy (above, note 24) 1–16 and Macran (above, note 1) 86. Cf. da Rios (above, note 2) 95–136 for a convenient reassemblage of all ancient *testimonia* pertaining to the life and work of Aristoxenus.

[26] Nothing is known of this Lamprus other than that he is not the celebrated musician mentioned by Plato, *Menex.* 236A and Aristoxenus as recorded by Plutarch, *De mus.* 1142B. Cf. Laloy (above, note 24) 11.

[27] Diels and Kranz (above, note 13) 421, *fr.* 46.3 (Lysis) and *fr.* 47.1 (Archytas).

[28] Spintharus' name was associated with numerous celebrities such as, Damon, Philoxenus, Socrates and Epaminondas. Cf. Laloy (above, note 24) 4–5.

[29] Diels and Kranz (above, note 13) 442–43, *fr.* 52.1–3.

ancient Greece, his theory as we have it has often been regarded more as a deterrent than as an aid to our understanding of Greek music. In fact, much of the scholarly controversy that exists to this day in the field of Greek music is largely accounted for by the positions that scholars have taken vis-à-vis Aristoxenus' theory. Thus, his English translator, H. S. Macran,[30] says of him in general approbation, "The conception, then, of a science of music which will accept its materials from the ear, and carry its analysis no further than the ear can follow; and the conception of a system of sound-functions, such and so many as the musical understanding may determine them to be, are the two great contributions of Aristoxenus to the philosophy of Music." On the other hand, the judgment of J. F. Mountford[31] expresses a more recent and generally accepted criticism of Aristoxenus' position:

> For him (sc. Aristoxenus) pure mathematics and physics had no attraction. He postulated that in music the ear is the sole and final arbiter and that a mathematical formula had little or nothing to do with music. In this he was absolutely wrong, so far as theory goes; and so far as the art of music is concerned, he was only partially right.... To rely only upon the ear for the data of a system of musical theory is to use a rough-and-ready method.

Mountford concludes that Aristoxenus' conception of musical intervals "proves to be a quite impenetrable barrier to a proper knowledge of the nature of Greek scales" and that his theory at best is "too unscientific to be of real service." According to R. P. Winnington-Ingram:[32]

> His (sc. Aristoxenus') importance, however, is very great, not only from his comparatively early date but because he claims to champion the direct musical consciousness against the scientific approach of some of his predecessors and contemporaries. But if they are under suspicion of letting irrelevant factors intrude into their calculations, he must be equally suspected of yielding to the attractions of symmetry and convenience.

Most recently W. D. Anderson,[33] expressing the received opinion respecting Aristoxenus' significance, dismissed Aristoxenus as a possible source of information on the modes or *harmoniai* of an earlier

[30] Macran (above, note 1) 89.

[31] In the Introduction (xxi) to K. Schlesinger, *The Greek Aulos* (London 1939).

[32] Winnington-Ingram (above, note 16) 195.

[33] W. D. Anderson, *Ethos and Education in Greek Music* (Harvard: Cambridge 1966) 18 and 27.

period, judging his theory to have "a certain complex majesty, but [taking] us into a realm of theoretical perfection which the Harmoniai of the earlier Hellenic period can hardly have known." According to Anderson, systems such as that of Aristoxenus would appear to amount to little more than "dead abstractions of theory divorced from musical practice."

The major objections to Aristoxenus' theory involve, it would seem, a fundamental reluctance to accept a system based on the postulated activity of a musically intuitive intelligence, itself unobservable, as Aristoxenus himself was at pains to admit (*Harm.* 41), and therefore, according to some scholars, yielding unmeasurable, hence unscientific, results. This attitude has tended, unfortunately, to obscure Aristoxenus' revolutionary insight into the nature of music.

H. S. Macran's eloquent appreciation of Aristoxenus' unique position in ancient theory has only recently been complemented by the penetrating appraisal of E. A. Lippman, who goes far to set Aristoxenus' concepts in their proper light:[34]

> Aristoxenus turns to melody—a human rather than a natural manifestation and typified in the voice—and his laws are still more closely bound up in the detailed and inherent nature of his data. He has learned from Aristotle how to define the province of a science, not only how to find its natural divisions but especially how to determine the nature of its principles. . . . the result of Aristoxenus' application of the Aristotelian outlook is an aesthetic capable of accounting for the detailed structural properties of musical perception.

Aristoxenus' rationally based principles as they were applied by him to music theory have been further set forth in exemplary form by Henderson.[35] Her statement of Aristoxenus' theoretical aims and methods does full justice to the earliest attempt by an ancient thinker to provide a systematic understanding of what centuries of pre-Aristoxenian musical tradition had left shrouded in darkness. Henderson states the case concisely:[36]

> As Aristoxenus recognized, real melody presupposed not a fixed scale or tuning, but a line on which the voice's potentially infinite stations could be determined only by ear and understanding (ἀκοή καὶ διάνοια). Given

[34] Lippman (above, note 8) 146.
[35] Henderson (above, note 3) 344–51.
[36] Henderson (above, note 3) 343.

a good ear to hear intervals, the mind must define them by melodic functions. The only sane divisions of musical space was by 'consonances' (i.e. the melodic progressions to the fourth, fifth and octave): these the ear could judge exactly, or within a hair's breadth, whereas it found other intervals 'dissonant' and variable in size.

As we have seen above, the assumption by Aristoxenus of the ear as arbiter and substitute for numerical method led Mountford and others to raise the objection that Aristoxenus' theory, grounded in the principle of aural intelligence, could only result in a rough-and-ready formulation, unscientific, overly-symmetrical and difficult to understand. This critical position fails to apprehend not only Aristoxenus' primary aim but the nature of music itself. On the other hand, implicit in Henderson's explanation of Aristoxenus' analysis of the facts of music is the recognition and assimilation of the radical core of Aristoxenus' philosophy. Under the stimulus of her exegesis of Aristoxenian theory, this article attempts to state in what respects Aristoxenus' delineation of one of man's most mysterious abilities is truly scientific.

III

Antiquity conferred on Aristoxenus the title "musician."[37] The title suggests that Aristoxenus was not merely a philosophically trained theoretician, but that he was, additionally, a musical practitioner, with assumptions about the art of music similar to those of a practicing musician.[38] Against such a background he recognized that the art of music is a complex of many interrelated parts, of which Harmonics, albeit of primary importance, is nonetheless only a part of the larger discipline. As he says (*Harm.* 22), "To be a musician, as we are always

[37] Cf. Wehrli (above, note 25) 68.

[38] *Mousikos* in its widest sense signifies *a man of letters, a scholar, a cultivated person,* for which see *LSJ* s.v. II.2 and J. A. Philip, "Mimesis in the *Sophistês* of Plato," *TAPA* 92 (1961) 455. Its construction with *mousikê*—vocal and instrumental music—suggests the specific meaning of *musician* in the technical sense of the word. Thus, for example: Ἀριστόξενος ὁ μουσικὸς θηλυνομένην ἤδη τὴν μουσικὴν ἐπειρᾶτο ἀναρρωννύναι, for which see Wehrli (above, note 25) 28, *fr.* 70. Cf. also Cicero, *De orat.* 3.33.132 who, in noting the professional specializations within the arts and sciences, sets the musicians (Aristoxenus and Damon) quite apart from the men of letters (Aristophanes and Callimachus).

insisting, implies much more than a knowledge of Harmonic, which is only one part of the musician's equipment, on the same level as the sciences of Rhythm, of Meter, of Instruments." If, then, Aristoxenus presents us here with the Harmonic only, it is not because he believed that to comprehend all of musical art;[39] it is just that he wished to devote an entire work to the principles underlying the production of melody. At the same time, he did not want his theory to be mistaken for something it is not. In this connection he relates the story of the students who came to Plato's lectures on the Good (*Harm.* 30) expecting to learn all about the material goods—riches, health, or strength—and were disappointed to hear only about arithmetic, geometry, and astronomy. In the same way he advises his students not to expect the *Harmonics* to reveal every aspect of the musical art. A good deal of the criticism leveled at Aristoxenus is based on the mistaken idea that the *Harmonics* is actually a general theory of music, when, in fact, as Aristoxenus had been at pains to make clear, it is only a systematization of the rules governing melodic production.

At stake, thus, was the determination of the most economical, explicit and formal principles that would account for music's expressive potential, while at the same time the standards of a logically conceived system would be met in which nothing was *ad hoc* or redundant. In approaching this task, Aristoxenus realized that the kinds of structures that must be postulated to underlie the musical expression were not demonstrable in mechanistic terms. That is, in order to do justice to man's ability to create music, it was not thought necessary by Aristoxenus to postulate numerical ratios inside man's brain, but rather a thinking substance, a musical intuition, to account for the musician's mastery of a complex and rule-governed skill. If the musician's utterances are made in accordance with the elements characterized as musical by Aristoxenus and with the rules ascertained by him to underlie these utterances, we may assume with Aristoxenus that such

[39] Aristoxenus wrote on various other aspects of music in addition to Harmonics. Nothing survives of these works save an incomplete treatise on Rhythm, for which see R. Westphal, *Die Fragmente und die Lehrsätze der Griechischen Rhythmiker* (Leipzig 1861). In addition to separate works on musical instruments, melodic composition, the dance in tragedy and other topics, he wrote what may have been a general theory of music, a *Peri Mousikês*. For references to these and other works by Aristoxenus, see Wehrli (above, note 25) *fr.* 69–94.

utterances are manifestations of the musician's mastery of the art. It is reasonable to suppose, moreover, that ancient Greek music, like the music of any other culture, had a general character deriving from the fact that its elements were governed by certain rules. The justification for Aristoxenus' particular composition of the rules of the Greek musical idiom is simply that he was a native practitioner of the art and, as such, knew intuitively what the elements of Greek music were. Though he does not record for us particular instances of Greek music, this not being his intention, he does provide a set of rules capable of generating the utterances he knew intuitively to be music. This system of rules, constituted as a "grammar" in the sense that it was capable of generating all and only those melodic sequences that are musically acceptable, depended on the musical intuition of the user as well as on the existence of certain universal properties of music—consonance and dissonance. Aristoxenus' system of rules is formal in the sense that, while it refers to actual elements of music (pitch and interval), it can be translated into formal terms. It is explicit in the sense that it states the relationship between the musical forms that by a series of logical steps are produced in proper sequence and combination, the interpretation of which depends on the mind of the user.

Implicit in Aristoxenus' statement of his theory is his recognition of the infinite possibilities on the sound continuum both in extension and in diminution (*Harm.* 15). As a consequence, melody in the abstract would admit of an infinite number of sequences. That is, the domain of music is infinite and boundless. If a theory attempted to describe specifically each and every permitted sequence it, too, would be infinite in length. The determination of the way in which musicians manage to produce from a finite system an infinite number and variety of combinations is the essence of Aristoxenus' theory. He saw certain basic processes in the structure of Greek music, a purely melodic music as opposed to harmonic in the modern sense, that could be reapplied recursively. At the same time these processes were themselves restricted by the practical limitations of the practitioners of the art. Thus Aristoxenus says (*Harm.* 14), "What the voice cannot produce and the ear cannot discriminate must be excluded from the available and practically possible range of musical sound." The imposition of limits *epi to mikron* and *epi to mega* on the infinite possibilities of sound, these limits dependent on musical intuition, constitute the Aristoxenian definition of music.

Aristoxenus' musician's understanding of what a musical work must comprise in order to attain the rank of true art is unexampled in the theoretical documents of antiquity. Laloy thus says of him,[40] "je ne crois pas que l'antiquité nous ait laissé sur la musique de pages plus justes et mieux senties que celles où il pose les conditions du jugement musical." To explain his superior understanding, Laloy suggests that Aristoxenus' doctrine adumbrates a rudimentary Kantian aesthetic, "une sorte de kantisme inconscient."[41] He does not press the point, however, in part on the grounds that Aristoxenus does not have a special word to denote intuition. Kantian aesthetics aside, the fact is that Aristoxenus did have such a word—*synesis*.

The notion of *synesis* in the sense of an innate mental faculty admits of no easy description. For Aristoxenus, as for others, it is a proposition of some complexity. There is no concrete means for representing its activity as, for example, by notational symbols. On these grounds Aristoxenus criticizes those "who aver that notation of melodies is the ultimate limit of the apprehension (τοῦ ξυνιέναι) of any given melody" (*Harm.* 39). The living tones of music as apprehended by the mind could no more be represented for him by symbols than could the letters of the alphabet represent the living tones of language for Herder.[42] What is responsible for the creation of music is not notation, or harmonic science or musical instruments (*Harm.* 42) any more than are the activities of the hand or mouth other than those of mere appurtenances. It is, rather, the apperception of a reflective being, or, as Aristoxenus says (*Harm.* 41), it is the "*synesis* buried deep in the soul" that is the creative force. This faculty, *synesis*, is made up of the ear and the intellect (*Harm.* 38), the ear providing the perception, the intellect with its ability to remember (*Harm.* 39) the discrimination. The powers of aural perception and mental apperception are combined in musical *synesis*—that unique human faculty that hears, remembers and distinguishes. Aristoxenus' a priori notion of musical *synesis* as the intellectual process responsible for the creation of music cannot be

[40] Laloy (above, note 24) 262.

[41] Laloy (above, note 24) 164.

[42] Johann Gottfried Herder, "Abhandlung über den Ursprung der Sprache," *Sämtliche Werke* 5, ed. Bernhard Suphan (Hildesheim 1967) 8.

justified in terms of Lippman's analysis, however. As Lippman sees it,[43] "The peculiarity of the method [advocated by Aristoxenus] is that hearing and reason do not really act together; they are assigned to distinct tasks. Thus reason is responsible for the logical structure of the whole science and of its particular arguments, as well as for determining the functional relationship between tones; but it does not participate in the judgment of the size of intervals; this depends solely on auditory discrimination." He adds further,[44] "consonance is a fact given in audition, and when dissonance is measured by means of consonance, the process of measurement transpires wholly within the sphere of hearing —reason and mathematics have nothing to do with it." But sensation and rational thought do not exhaust the sources of knowledge. Mediating between the two is some other faculty of understanding—intuition, competence, apperception—and it is this faculty that lies at the heart of Aristoxenus' theory. Lippman's remarks, above, thus do not touch Aristoxenus' deeper understanding of the true principle of music. They would explain only how intonation is rendered more exact. They do not account for the composer's ability to image music in his mind nor for the listener's ability to react to its affective power.

To be sure, the interaction of sensation and intuitive knowledge raises a vast complex of philosophical questions. For the musician, however, it is essentially an underived principle conceived by him to underlie all his creative activity. A musician "creates music by 'hearing it out' . . . in his creative imagination through his 'mind's ear'." The capacity to conceptualize musical tones "is a condition for learning, for retention, for recall, for recognition, and for the anticipation of musical facts."[45] This is the musician's fundamental principle which Aristoxenus adopts as a primary truth (*Harm.* 44). In this capacity lies the ability to "know" consonance, to measure dissonance, to determine the consequent collocations of tones into basic systems capable of generating melody.

A generating system of music may be explained by considering music as an act inseparable from the scale system—or set of rules for collocating pitches—that is useful for performing the musical act or

[43] Lippman (above, note 8) 149.
[44] Lippman (above, note 8) 151.
[45] Carl E. Seashore, *Psychology of Music* (New York 1967) 5–6.

range of acts. That is, the scale and the musical act are considered as a unity seen from two different points of view. The musical scale in which relationships between one pitch and another are established as functional in particular ways is, in this sense, akin to the rules of a game such as chess. The rules of chess, for example, constitute and regulate the game; but the existence of the game is also logically dependent on the rules. The rules create, as it were, the very possibility of playing the game.[46] With this in mind, it is useful to consider a case in which the music of a composer and the rules are both familiar to us as, for example, the case of Claude Debussy. Debussy's music is markedly distinctive to everyone; its ethos, we might say, is consistently recognizable. The language used to describe this ethos is characteristically evocative: "shimmering," "bloodless," "gossamer," "crepuscular," "iridescent," etc. In terms of theory, the system that generates Debussy's distinctive melodic line (and harmonic, i.e. chordal structure) is the scale composed of whole tones only.[47] This scale of whole tones is an abstraction having no reference to absolute pitch; it exists in theory in a distinct interval sequence, but it can be conceptualized or imaged by the musically intuitive mind. The music it constitutes, the music logically dependent on its rules of collocation, is recognized by other minds as distinctive in ethos. In this sense the concept of the whole tone scale is inseparable from the musical art of Debussy. Deeper analysis would reveal that the apparently infinite harmonic and melodic combinations of Debussy's music are dependent on a set of iron-clad and limiting rules that determine the dynamic relationships between each pitch of the scale. Following Aristoxenus' prescription, the learning of these rules would not alone guarantee the ability to compose the music of Debussy; for that one would need Debussy's individual genius. Knowledge of the rules would, however, enable one to compose in the style of Debussy. In order, then, to account for the

[46] Cf. J. R. Searle, *Speech Acts* (Cambridge 1970) 33–42, where various categories of rules are examined.

[47] This is sometimes called the Six-Tone scale, the seventh tone merely completing the octave above the fundamental. Under this system, progressions of chords are generated—e.g. unresolved dominant sevenths and ninths—which tend to obscure central tonalities. Using these chords as the impressionistic painters used bits of color to evoke images, Debussy commingled them in various combinations of species, or else concentrated them in sequences without any reference to key, producing thereby a music as mobile as water.

expressive potential of Debussy, one has two choices: either to record every note and combination of notes written by Debussy or to extrapolate a cognitive system which would provide in explicit and formal terms the substructure of Debussy's musical activity. The latter option was the sort adopted by Aristoxenus.

The Aristoxenian system has been presented with admirable clarity and concision by Henderson[48] who explains that "its essential character lies in the logical priority of the fixed notes which hold the melody between the iron girders of consonant progressions . . ."[49] The entire system is constructed on the basic unit of the tetrachord bounded by the fixed notes of the smallest consonant interval, the fourth, whose fixed pitches are determined by the ear. The combined couplings of tetrachord upon tetrachord by disjunction and conjunction result in a two-octave extension, as, for example, B—a′, the missing low pitch (A) being supplied by an added note or *phthongos proslambanomenos*. Each tetrachord is filled in with two movable notes whose collocations in the diatonic genus are established by tuning from an initial pitch in ascending fourths and descending fifths. Thus, tuning by consonances from a pitch E, for example, will fix the proper pitches of two conjunct tetrachords in the diatonic genus:[50]

E–A, A–D, D–G, G–C, C–F, F–B♭, B♭–E♭, E♭–A♭

This yields the pitches of the sequence:

B♭ C D E♭ F G A♭

As Aristoxenus explains (*Harm.* 55), the determination of intervals in the other direction requires the reversed tuning by consonances to ascending fifths and descending fourths. Tuning by consonances again from the pitch, E, will fix the proper pitches of two disjunct tetrachords in the diatonic genus:

E–B, B–F♯, F♯–C♯, C♯–G♯, G♯–D♯, etc.

This yields the pitches of the sequence:

E F♯ G♯ A B C♯ D♯ E

[48] See above, note 35.

[49] Henderson (above, note 3) 345.

[50] Aristoxenus, *Harm.* 55, explains this means of determining the loci of all pitches through consonant relations. Cf. Macran (above, note 1) 285–86.

The alteration of two pitches, F♯ to F♮ and C♯ to C♮ will produce the chromatic genus. The further flatting of these pitches by a quarter-tone (*diesis*), F♮ to E^{+} and C♮ to B^{+}, will produce the enharmonic genus. Additional alterations yield other nuances (*chroai*) within the tetrachord limits. Each note of the two-octave system was designated by a name, an adjectival derivative modifying an implied noun, *chordê*, together with the tetrachord to which it belonged, the resulting terminology being somewhat formidable but serviceable for theoretical purposes. From this two-octave system, octave segments or species (*eidê*) were derived, each of which was designated by a modal name, Mixolydian, Lydian, Phrygian, Dorian, etc. This, in skeletal form, is the system developed by Aristoxenus from the initial determination of fixed pitches by consonances. It is not a description of music but a delineation of the basic elements conceptualized by the mind of the composer in terms of which his musical utterance is formulated. That is, it constitutes the rules underlying melodic progression, these rules being intuited by the musically competent mind.

To illustrate how a comparable set of rules would operate, one might consider a melodic progression which is generated by the rules of sixteenth century Canto Fermo writing. The melodic line

```
          F
            E
  D     D     D
C     C         C       C
    B                 B
                  A
                    G
```

is musical but

```
                      C
B   B   B
  A   A   A         A
            G   G
              F   F
```

is not. The underlying structure C D E F G A B C does not itself provide the reasons why the one melody is musical and the other unmusical, but the rules of scale-step attraction do.[51] These rules, internalized and apperceived by the writer musically conscious of Canto Fermo, are the generating factors responsible for the musical melodic line. Thus, the internal relationships between the elements of C D E F G A B C cannot be thought of as separate from the melodic Canto Fermo.

To judge that Aristoxenus' symmetrical system is unrepresentative of Greek musical practice and exists solely in abstract theory is to misinterpret its goal. Rather, if one considers it to be a representation of the way in which the ancient musical mind ordered the elements of music, and not a description of the musical anatomy alone, the implication would be that the Aristoxenian system reflects a remarkably complex and highly developed art form that was in no sense primitive. That so little is known for certain about this musical art stems in part from an almost total lack of actual musical examples, as well as from the numerous difficulties connected with the interpretation of the theoretical evidence. Nonetheless, it appears from the considerations of this paper that progress in understanding the nature of Greek music can best be made by approaching the problem from the point of view that Aristoxenus represents an *intelligence du milieu* and as such, expresses a musical competence which is reflective of that milieu. Because of this fact, studies which do not discriminate between the nature of the testimony offered by Aristoxenus and that of others proceeding at second hand or from opposite epistemological orientations will tend to level out differences that are highly significant for an understanding of Greek music.

[51] The functional resolutions of the active scale steps—leading-tone to tonic, submediant to dominant, sub-dominant to mediant—are explained by P. Goetschius, *Elementary Counterpoint* (New York 1910) 5–7. As Goetschius observed (p. 5), "Probably the most vital law of melody is that which is grounded in the relations and interactions of the primary harmonies of the key, and which determines the *direction of certain Scale-steps.*"