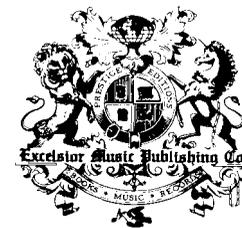


**A History of  
'Consonance'  
and  
'Dissonance'**

*by*

*James Tenney*



**Excelsior Music Publishing Company, New York**

**A HISTORY OF: 'Consonance' and 'Dissonance'**

Published by Excelsior Music Publishing Company  
15 West 44th Street, New York, N.Y. 10036

Typesetting, music engraving and layouts by:  
Excelsior Typographers and Engravers, Unltd.  
(A division of Excelsior Music Publishing Co.)

Distributed to the Book Trade by:  
Scientific and Technical Book Service, Ltd.  
50 West 23rd Street, New York, N.Y. 10010

Distributed to the Music Trade by:  
Theodore Presser Company  
Bryn Mawr, Pa. 19010

©1988 by Excelsior Music Publishing Co.

International Copyright Secured

All rights reserved. No portion of this book may be reproduced or utilized in any form or by any means, electronic or mechanical, including electrostatic or photo copying, recording, information storage or retrieval systems, or computers, without prior permission in writing from the publishers.

**Library of Congress Cataloging-in-Publication Data**

Tenney, James. 1934 –  
A history of consonance & dissonance

Includes bibliographies.

1. Harmony—History. 2. Music—Theory. 3. Music—Philosophy and aesthetics.

I. Title. II. Title: History of consonance and dissonance.

ML444.T45 1987 781.3 86-82304

ISBN 0-935016-99-6

Manufactured in the United States of America

## Contents

*Introduction / 1.*

### **Part One:**

#### **From Antiquity through the "Ars Antiqua"**

Section I. *The pre-polyphonic era (CDC-1) / 9*

Section II. *The early-polyphonic period, ca. 900-1300 (CDC-2) / 17.*

Notes: *Section I and II / 32.*

### **Part Two:**

#### **From the "Ars Nova" through the "Seconda Pratica"**

Section III. *The contrapuntal and figured-bass periods, ca. 1300-1700 (CDC-3) / 39.*

Notes: *Section III / 59.*

### **Part Three:**

#### **From Rameau to the Present**

Section IV. *Rameau and his successors (CDC-4) / 65.*

Section V. *Helmholtz and the theory of beats (CDC-5) / 87.*

Section VI. *Summary and Conclusions: Toward a New Terminology / 95.*

Notes: *Section IV, V, and VI / 105.*

**Appendix / 109.**

## INTRODUCTION

There is surely nothing in the language of discourse about music that is more burdened with purely semantic problems than are the terms *consonance and dissonance*. A comparison of some of the definitions of these words to be found in current dictionaries, harmony textbooks, and books on musical acoustics indicates that there is considerable confusion and disagreement as to their meaning—if indeed there *is* any meaning still to be attributed to them.<sup>1</sup> Consider, for example, the following:

CONSONANCE...agreement of sounds; pleasing combination of sounds...

DISSONANCE...an inharmonious or harsh sound or combination of sounds...

*(The Oxford English Dictionary, 1961)*<sup>2</sup>

CONSONANCE...a combination of musical tones felt as satisfying and restful; *specif*: an interval included in a major or minor triad and its inversions...

DISSONANCE...an unresolved musical note or chord; *specif*: an interval not included in a major or minor triad or its inversions...

*(Webster's Third New International Dictionary, 1971)*<sup>3</sup>

A combination of two or more tones of different frequencies that is generally agreed to have a pleasing sound is called a *consonance*.

*(Backus, The Acoustical Foundations of Music, 1969)*<sup>4</sup>

Stable intervals are defined as *consonant*; unstable intervals...as *dissonant*...the term *dissonant* does not mean discordant or unpleasant. On the contrary, the most interesting and beautiful sounds in music are usually the dissonant ones...

*(Kraft, Gradus, 1976)*<sup>5</sup>

CONSONANCE, DISSONANCE. The terms are used to describe the agreeable effect produced by certain intervals...as against the disagreeable effect produced by others...or similar effects produced by chords...

*(The Harvard Dictionary of Music, 1953)*.<sup>6</sup>

Note that some of these definitions have “functional” implications, others do not, and some equate *consonant* with “pleasant,” *dissonant* with “unpleasant,” while others do not—and one of them actually reverses the equation.<sup>7</sup>

## 2. Introduction

A historical context for the semantic problems associated with *consonance* and *dissonance* is suggested (though not pursued very far) by Paul Hindemith in the *Craft of Musical Composition*, when he says:

The two concepts have never been completely explained, and for a thousand years the definitions have varied. At first thirds were dissonant; later they became consonant. A distinction was made between perfect and imperfect consonances. The wide use of seventh-chords has made the major second and the minor seventh almost consonant to our ears. The situation of the fourth has never been cleared up. Theorists, basing their reasoning on acoustical phenomena, have repeatedly come to conclusions wholly at variance with those of practical musicians.<sup>8</sup>

And yet—in addition to being an eminently “practical” musician—Hindemith himself was certainly one of the most prominent of modern theorists “basing their reasoning on acoustical phenomena,” and he does in fact imply a conception of consonance and dissonance which is quite different from the purely functional definition found in most contemporary textbooks on traditional harmony when he says, in the very next paragraph:

Between the octave as the most perfect and the major seventh as the least perfect intervals, there is a series of interval-pairs which decrease in euphony in proportion as their distance from the octave and their proximity to the major seventh increases. The tritone belongs neither to the realm of euphony nor to that of cacophony...<sup>9</sup>

Arnold Schoenberg had been more careful to avoid such correlations of consonance and dissonance with “euphony” and “cacophony” when he wrote (in “Problems of Harmony,” 1934):

Dissonances, even the simplest, are more difficult to comprehend than consonances. And therefore the battle about them goes on throughout the length of music history... The criterion for the acceptance or rejection of dissonances is not that of their beauty, but rather only their perceptibility.<sup>10</sup>

A few years earlier (in “Opinion or Insight?”, 1926), he had written:

‘The emancipation of the dissonance’. That is to say, it came to be placed on an equal footing with the sounds regarded as consonances (in my *Harmonielehre* the explanation of this lies in the insight that consonance and dissonance differ not as opposites do, but only in point of *degree*... consonances are the sounds closer to the fundamental, dissonances those farther away... their comprehensibility is graduated accordingly, since the nearer ones are easier to comprehend than those farther off).<sup>11</sup>

## Introduction 3.

Still another interpretation of *consonance* and *dissonance* is suggested by the following passage from Igor Stravinsky’s *Poetics of Music*:

...the concepts of consonance and dissonance have given rise to tendentious interpretations that should definitely be set aright... Consonance, says the dictionary, is the combination of several tones into an harmonic unit. Dissonance results from the deranging of his harmony by the addition of tones foreign to it. One must admit that all this is not clear. Ever since it appeared in our vocabulary, the word dissonance has carried with it a certain odor of sinfulness... Let us light our lantern: in textbook language, dissonance is an element of transition, a complex or interval of tones which is not complete in itself and which must be resolved to the ear’s satisfaction into a perfect consonance... But nothing forces us to be looking constantly for satisfaction that resides only in repose. And for over a century music has provided repeated examples of a style in which dissonance has emancipated itself...<sup>12</sup>

Although this is a plausible description of certain aspects of late 19th- and early 20th-century developments leading toward what Schoenberg had called “the emancipation of the dissonance,” our “lantern” does not seem much brighter than before with regard to the more basic question of the meaning of the words *consonance* and *dissonance*. Are we to interpret *dissonance*, for example, as meaning “not complete in itself,” as implied here by Stravinsky, or as less “comprehensible” (Schoenberg), less “euphonious” (Hindemith), less “agreeable” or “pleasant” (*The Oxford Dictionary*, Backus, *et al*), more “beautiful” (Kraft), more “active” or “unstable” (Kraft and others), etc.—or as some combination of some or all of these meanings?

It seems obvious that our first problem is indeed a semantic one, and that—among many other difficulties which ensue from this—until this semantic problem has been solved any speculative theory that might be developed in an effort to explain the *nature* of consonance and dissonance in musical perception is doomed to failure from the very start, since there is no common understanding about what it is that such a theory ought to “explain.” What is perhaps not so obvious is that the semantic problems associated with *consonance* and *dissonance* are rooted in the complex *historical* development of what I will call the “consonance/dissonance-concept” (or CDC) in western musical culture, and that a careful analysis of that historical development is the only hope we have of unraveling the tangled network of meanings and interpretations which so confuse the issue today. In *The Style of Palestrina and the Dissonance*, Knud Jeppesen said:

When we encounter a...difficulty of linguistic-psychologic nature, it generally repays the trouble to delve into history and, seeking here anterior forms of the linguistic feature in which we are especially interested, to work our way through its genetic course...<sup>13</sup>

Accordingly—and in the spirit of this observation by Jeppesen—this book

will examine the historical development of the CDC as it can be deduced (primarily) from theoretical writings from the 3rd century B.C. through the 19th and early 20th centuries. It will show that the words *consonance* and *dissonance* (and/or their Greek, Latin, and modern-language equivalents) have been used, historically, in at least *five different ways*—expressing five distinctly different forms of the CDC. Before the rise of polyphonic practice they were used in an essentially melodic sense, to distinguish degrees of affinity, agreement, similarity, or *relatedness between pitches* sounding successively. During the first four centuries of the development of polyphony they were used to describe an aspect of the *sonorous character* of simultaneous dyads, relatively independent of any musical context in which they might occur. In the 14th century the CDC began to change (again) in conjunction with the newly developing rules of counterpoint, and a new system of interval-classification emerged which involved the *perceptual clarity* of the lower voice in a polyphonic texture (and of the text which it carried). In the early 18th century, ‘consonance’ and ‘dissonance’ came to be applied to *individual tones* in a chord, giving rise to a new interpretation of these terms which would eventually yield results in diametric opposition to all of the earlier forms of the CDC. Finally—in the mid-19th century—a conception of consonance and dissonance arose in which ‘dissonance’ was equated with “roughness,” and this had implications quite different from those of earlier forms of the CDC. These five different conceptions of consonance and dissonance will here be called CDC-1, CDC-2...(etc.)...through CDC-5, in the order of their historical emergence, and the development of each of these forms of the CDC will be analyzed in their natural chronological sequence. In order to further clarify the intentions and scope of this book, certain additional distinctions will have to be made, as follows:

First, it is absolutely essential that we distinguish between *conceptions* of consonance and dissonance, on the one hand, and on the other, explanatory *theories* of, aesthetic *attitudes* toward, and practical *uses* of consonance and dissonance. In spite of the obvious and intimate interrelations between these various aspects of the larger problem of consonance and dissonance, they have each followed a relatively independent course of historical development. Thus, for example, the debate which raged in the early 17th century between Artusi and the brothers Monteverdi involved *disagreements regarding the proper use* of dissonance—and thus also aesthetic attitudes toward consonance and dissonance—but no essential disagreement regarding the meaning of these terms—and thus of the *conception* of consonance and dissonance. This book is not intended to be a history of consonance/dissonance “treatment” as such, or a history of theories of consonance and dissonance, but rather a history of the underlying *conceptions* of consonance and dissonance, and these other aspects of the problem will be dealt with only to the extent that they may be helpful in clarifying the nature of these conceptions in a given historical period.

Second, the words *consonance* and *dissonance* seem to have been used—in every historical period—in two different grammatical senses, which I will distinguish as *qualitative* vs. *entitive*, corresponding to their use as “abstract” vs. “concrete” nouns. The first of these refers to the property, attribute, or *quality* associated with a sound or aggregate of sounds, while the second refers

to the sound or aggregate itself which *manifests* that quality. Which of these two senses is intended is generally made clear by the context and/or by the presence or absence of certain grammatical “markers” (e.g. the use of an article, and the possibility of pluralization of the concrete noun expressing the entitive sense). Several important words frequently used in musical discourse have this dual nature—e.g. *form*, *structure*, *texture*, etc.—and we generally have no difficulty in distinguishing the two meanings. But since the historical developments of the CDC sometimes involved a change of meaning or usage of one of these forms without a corresponding change in the other, the descriptive terms defined above will be found useful in tracing those historical developments.

Finally, in order to clarify my own uses of the words *consonance* and *dissonance* in this book, the following typographical procedures will be adopted: (1) italicization—when not obviously intended merely for *emphasis* of a word or phrase—will be used in the conventional way to mean the word itself (e.g. *consonance*, *concord*, *consonantia*, *symphonia*, etc.); (2) when the reference is to the semantic “cluster” composed of the written word plus any or all of its cognates and equivalent forms, single quotation marks will be used (e.g. ‘consonance’ = *consonance/concord/consonantia/symphonia*, etc.). But note here that—since such semantic clusters hardly have any real existence separable from the meanings they carry in common—a phrase like “‘consonance’ and ‘dissonance’” (as used in the title of this book) becomes indistinguishable from the term “consonance/dissonance—concept”—generally abbreviated here to “CDC”; (3) double quotation marks will be used when the reference is to some writer’s (or group of writers’) actual or imagined use of a word *or its equivalents* (thus “consonance” might stand for *symphonia* in Aristoxenus, *concordantia* in Odington, *consonanza* in Zarlino, etc.); and (4) no special markers will be used when the words are intended to refer to the acoustical/musical/perceptual *phenomenon* itself—whatever that may have been during the period under consideration—or (in the entitive sense) to the sounds in which that phenomenon was manifested.

## **Part One**

**From Antiquity through the  
“Ars Antiqua”**

## Section I

### The pre-polyphonic era (CDC-1)

In most pre-9th-century theoretical sources, the cognates of *consonance* and *dissonance*—or of related words like *concord* and *discord*, *symphony* and *diaphony*, and even our more general term *harmony*—refer neither to the sonorous qualities of simultaneous tones nor to their functional characteristics in a musical context but rather to some more abstract (and yet perhaps more basic) sense of *relatedness* between sounds which—though it might determine in certain ways their effects in a piece of music—is logically antecedent to these effects. Among the Pythagoreans, as Arthur Koestler reminds us (in *The Sleepwalkers*, 1959):

..the concept *armonia* did not have quite the same meaning that we lend to “harmony.” It is not the pleasing effect of simultaneously-sounded concordant strings—“harmony” in that sense was absent from classical Greek music—but something more austere: *armonia* is simply the attunement of the strings to the intervals in the scale, and the pattern of the scale itself. It means that balance and order, not sweet pleasure, are the law of the world.<sup>14</sup>

Edmond de Coussemaker had said essentially the same thing (if somewhat less colorfully) a hundred years earlier, when he wrote (in his *Histoire de l’Harmonie au Moyen Age*, 1852):

The word “harmony”...signified to the Greeks the arrangement or ordering of sounds considered with respect to the melodic relationship between their pitches. It was not at all (concerned with) the mixture of several sounds striking the ear at the same time... We do not mean to say by this that music (involving) simultaneous sounds was excluded from Greek treatises on music, or that it is only a question of melody; one finds there in fact more than one passage where (the word) is used in the sense we call “harmony.” We only wish to demonstrate that the word “harmony” did not have for the Greeks the restrictive meaning that it has today, and that one would be in error if one took it in this sense.<sup>15</sup>

In fact, *armonia* (or *harmonia*) had an earlier meaning quite unrelated to music. In *Pythagoras and the Pythagoreans* (1966), J.A. Philip says of this word:

Its primary meaning is not musical concord but a “fitting together” produced by a craftsman such as to result in a

unified object, or “perfect fit”...It is in this sense that the word is often used in other than Pythagorean contexts... Thus the primary sense is that of a principle producing a unified complex, and, deriving from this sense, that of a complex in musical sound and, finally, such a complex as a succession of sounds, a type of scale or mode expressible in numerical ratios which state how the sounds “fit together.”...In the Presocratics we find the word used first by Heraclitus largely in a musical sense of an accord or fitting-together of sounds in a melody, each note “fitting” that which precedes it (and not as what we call harmony, part-singing or polyphonic music)...Though we find that the Pythagorean usage is predominantly musical...the earlier sense of a fitting-together-into-one imposed by a craftsman is often also present.<sup>16</sup>

The opening sentence of *The Harmonics* of Aristoxenus (3rd century, B.C.) confirms this purely melodic connotation of the term “harmonic” (*harmoniken*):

The branch of study which bears the name of Harmonic is to be regarded as one of the several divisions or special sciences embraced by the general science that concerns itself with Melody.<sup>17</sup>

and in a later passage, he says:

We shall now proceed to the consideration of Harmonic and its parts. It is to be observed that in general the subject of our study is the question, In melody of every kind, what are the natural laws according to which the voice in ascending or descending places the intervals?<sup>18</sup>

In “Ancient Greek Music,” Isobel Henderson says that the discipline of “harmonics”:

...meant *tuning*, or acoustic theory. Greek postulates were melodic and heterophonic, and ignored ‘harmony’ in our sense...The term ‘consonant’ (*symphonos*) refers to *melodic* progressions. Music had nothing nearer to ‘harmony’ than choirs doubling at the octave...<sup>19</sup>

and concerning this word ‘symphony’ and its cognates, Gustave Reese has written:

The original meaning of *symphonia* was “a concord of sounds,” and the fourth, fifth, and octave were, in fact, consonances for both the Greeks and the medieval “symphonists” [i.e. the singers/composers/theorists of early organum]—but from different points of view. Basically, the intervals constituting the consonances were melodic (i.e.

successively sounded) with the Greeks, harmonic (i.e. simultaneously sounded) with the “symphonists.”<sup>20</sup>

The purely melodic implication—to Aristoxenus—of the word *symphonia* (translated by Macran as “concord”) can be seen quite clearly in the following passage from the *Harmonics*:

Whatever be the genus, from whatever note one starts, if the melody moves in continuous progression either upwards or downwards, the fourth note in order from any note must form with it the concord [*symphonon*] of the fourth, or the fifth note in order from it the concord of the Fifth. Any note that answers neither of these tests must be regarded as out of tune [*asymphonoi*] in relation to those notes with which it fails to form the above-mentioned concords.<sup>21</sup>

For Aristoxenus, the fourth was the *first* consonance, but simply because it was the smallest. The others were the fifth, the octave, and several of the composite intervals formed by octave-expansion of the fourth, fifth, and octave. Intervals smaller than the fourth, and those lying between the fourth and fifth, and between the fifth and the octave (and the composite forms of these) were all dissonant (*diaphonos*, “discordant”). After thus classifying the various intervals used in melody, Aristoxenus says:

So far we have been stating what we have learned from our predecessors; henceforth we must arrive at our conclusions unaided.<sup>22</sup>

The most prominent and influential of his predecessors, of course, were the Pythagoreans. Aristoxenus—like his more celebrated teacher, Aristotle—was highly critical of the Pythagoreans’ numerological mysticism, and has therefore come to represent to us an anti-Pythagorean point of view, as expressed, for example, in the following passage:

...we hold that the voice follows a natural law in its motion, and does not place the intervals at random. And of our answers we endeavour to supply proofs that will be in agreement with the phenomena—in this unlike our predecessors. For some of these introduced extraneous reasoning, and rejecting the senses as inaccurate fabricated rational principles, asserting that height and depth of pitch consist in certain numerical ratios and relative rates of vibration—a theory utterly extraneous to the subject and quite at variance with the phenomena...<sup>23</sup>

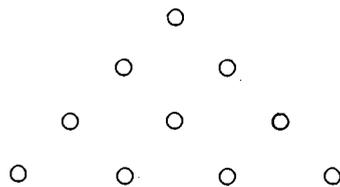
And yet Aristoxenus does not offer an alternative explanation as to *why* certain intervals were judged to be ‘consonant’ and others ‘dissonant’, and his classification of the fourth, fifth, and octave (and their compounds) as “concord” —and of all other intervals as “discords”—is perfectly consistent with the results of Pythagorean doctrine, if not with its philosophical rationale. The universality of the ‘consonance’ and ‘dissonance’ categories during this period

is exemplified again in the following passage from the same work:

If...a certain note be given, and it be required to find a certain discord [*diaphonon*] below it, such as the ditone...one should take the Fourth above the given note, then descend a Fifth, then ascend a Fourth again, and finally descend another Fifth...If it be required to ascertain the discord in the other direction, the concords must be taken in the other direction.<sup>24</sup>

This constitutes a set of instructions for tuning what has come to be called a "Pythagorean scale," whose pitches are all derived from a sequence of tunings in perfect fourths, fifths, and octaves. The association of these three basic "concords" with simple integer ratios between string-lengths was an essential element in the Pythagorean tradition, generally considered to have been discovered by Pythagoras himself some three centuries earlier.

In its earliest manifestation, then, CDC-1 involved relations between pitches in a purely melodic context. Intervals that were precisely and *directly* tunable were considered consonant, while all others—those which were tunable only *indirectly*—were dissonant, and there were no degrees of relative consonance or dissonance in between these two extremes. Since it will be of relevance to our discussion of later developments of the CDC, we must consider the question: why was the class of "concords" thus limited to just these three basic intervals (and their octave-compounds)—the fourth, fifth, and octave? The answer to this question involves what the Pythagoreans called the "tetraktys (or quaternary) of the decad"—the geometric or "figurate" representation of the number 10 as the sum of the first four integers (i.e. 1 2 3 4=10), arranged in triangular fashion as follows:



The purely musical significance of this "tetraktys of the decad" resides in the fact that the string-length ratios for the fourth, fifth, octave, twelfth (but not the eleventh), and double octave involve only these first four integers (i.e. 4/3, 3/2, 2/1, 3/1, 4/1, but not 8/3).<sup>25</sup> But the decad had significance for the Pythagoreans that went far beyond this musical application. According to a later Pythagorean, Theon of Smyrna (2nd century, A.D.):

The importance of the quaternary...is great in music because all of the consonances are found in it. But it is not only for this reason that all Pythagoreans hold it in highest esteem: it is also because it seems to outline the entire nature of the

universe. It is for this reason that the formula of their oath was: "I swear by the one who has bestowed the tetraktys to the coming generations, source of eternal nature, into our souls." The one who bestowed it was Pythagoras, and it has been said that the tetraktys appears indeed to have been discovered by him.<sup>26</sup>

This aspect of Pythagorean philosophy had been summarized much earlier by Aristotle (in the *Metaphysics*), as follows:

...the Pythagoreans...devoted themselves to mathematics; they were the first to advance this study, and having been brought up in it they thought its principles were the principles of all things. Since of these principles numbers are by nature the first, and in numbers they seemed to see many resemblances to the things that exist and come into being...since, again, they saw that the attributes and the ratios of the musical scales were expressible in numbers; since, then, all other things seemed in their whole nature to be modeled after numbers, and numbers seemed to be the elements of all things, and the whole heaven to be a musical scale and a number. And all the properties of numbers and scales which they could show to agree with the attributes and parts and the whole arrangement of the heavens, they collected and fitted into their scheme; and if there was a gap anywhere, they readily made additions so as to make their whole theory coherent. E.g. as the number 10 is thought to be perfect and to comprise the whole nature of numbers, they say that the bodies which move through the heavens are ten, but as the visible bodies are only nine, to meet this they invent a tenth—the 'counter-earth'. We have discussed these matters elsewhere...<sup>27</sup>

In spite of the disdain which Aristotle (and Aristoxenus) evidently felt for such notions, the Pythagorean viewpoint exerted a very powerful influence on later Medieval philosophy in general, and music theory in particular—an influence that continued even into the Renaissance and beyond. As will be seen later, the limit or boundary imposed on the conception of 'consonance' by the tetraktys of the decad was finally broken only by an appeal to cosmological arguments which were themselves fundamentally Pythagorean in spirit.

The same two-fold classification of intervals is to be found in the writings of nearly every subsequent theorist (whether "Pythagorean" or "Aristoxenian") until about the 9th century.<sup>28</sup> Thus, for example, Cleonides, in the *Harmonic Introduction* (1st c. A.D.)—obviously borrowing from Aristoxenus—says:

Of intervals the differences are five, in that they differ from one another in magnitude, and in genus, and as the symphonic from the diaphonic, and as the composite from the incomposite, and as the rational from the irrational...The symphonic

#### 14. *The pre-polyphonic era (CDC-1)*

intervals are the diatessaron, diapente, diapason, and the like [presumably the octave-compounds of these]. The diaphonic intervals are all those smaller than the diatessaron and all those lying between the symphonic intervals...<sup>29</sup>

He also defines the terms 'symphony' and 'diaphony' as follows:

...symphony is a blending of two notes, a higher and a lower; diaphony, on the contrary, is a refusal to two notes to combine, with the result that they do not blend but grate harshly on the ear.<sup>30</sup>

In the treatise by Theon of Smyrna we find the following:

The interval is defined as the relationship of sounds among each other, such as the fourth, the fifth and the octave...Among the intervals, some are consonant, others dissonant...[individual tones] form a consonance with each other when a sound which is produced by a string of an instrument causes the other strings to resonate by means of a certain affinity, a kind of sympathy; and also, when two sounds being produced at the same time result in a mixed sound which has a sweetness and a quite particular charm.<sup>31</sup>

Similarly, in his *Introduction to Harmonics* (2nd c.), Gaudentius says:

Consonant tones, when they are produced simultaneously, either by striking or blowing on an instrument, always result in the same musical sound, whether the motion is from the low tones to the high, or the high tones to the low...Dissonant tones, when they are produced simultaneously...never seem to be the same in any part of the musical sound...[and] do not show any evidence of blending with each other...There are six consonances in the perfect system [the fourth, fifth, octave, eleventh, twelfth, and double octave].<sup>32</sup>

Again in the 6th century, we find essentially the same definition of 'symphony' as that given by Cleonides four hundred years earlier, and the same set of three basic "symphonic" intervals, in the *Institutiones* (ca. 550-562) by Cassiodorus:

Symphony is the fusion [*temperamentum*] of a low sound with a high one or of a high sound with a low one...There are six symphonies: diatessaron, diapente, diapason, diapason and diatessaron together, diapason and diapente together, [and] disdiapason [*sic*—the double octave].<sup>33</sup>

Whether these categorical classifications were meant to refer to successive or to simultaneous tones—or both—is not always altogether clear in these "post-classical" but pre-polyphonic sources. The use of words like "combine," "blending," and "fusion" might tend to suggest simultaneity, and—referring

#### *The pre-polyphonic era (CDC-1)* 15.

to the passage quoted above from Gaudentius—Curt Sachs has written (in *The Rise of Music in the Ancient World*, 1943):

The ancient definition of consonance had a remarkably modern flavor [and later]... Consonances, Boethius says, are "pleasant," and the pseudo-Aristotelian Problem 19:13 states that "any consonance is sweeter than a single note." And are we supposed to believe that the Greeks did not use them?<sup>34,35</sup>

There are persuasive arguments, however, against an interpretation of 'consonance' and 'dissonance' in these early-Medieval sources as having been intended primarily as descriptions of simultaneous sounds. In "The Birth of Polyphony," Dom Anselm Hughes wrote:

...It seems that there was a formal, almost scholastic terminology in use from the time of Cassiodorus (479-575) and St. Isidore of Seville (565-636) down to Aurelian of Reome and Remy of Auxerre in the ninth century, according to which *harmonia* was used of melody, and *symphonia* of consonant intervals...Borrowing...from Cassiodorus, [Isidore] describes *symphonia* as a consonant interval, accurately sung or played, the opposite of *diaphonia* (dissonance). This definition reappears in Aurelian; but there is nothing to show that the definition of consonance and dissonance refers to simultaneous, rather than successive, sounds, until we come to the specific explanation given by Regino of Prum (d. 915) in his *De harmonica institutione*. The use of *diaphonia* in a purely melodic sense persisted even after polyphony was well established.<sup>36</sup>

No matter how the debate as to whether these Medieval theorists meant to refer to the qualities of simultaneous tones is ultimately resolved, one thing at least is clear: 'symphonic' and 'diaphonic' were terms generally used by them—as by Aristoxenus—to describe *relations between pitches*, conceived in a melodic context. The observation that two tones forming a "symphonic" interval *also* "result in the same musical sound" (Gaudentius), or that one of those tones sounded on a string "causes the other strings to resonate by a certain affinity..." (Theon), merely *confirmed* the essential point these writers intended to demonstrate—namely that such tones were in a concordant relation to each other, and that such a relation was the essential basis for melodic organization.

In these earliest sources, then, the terms 'consonance' and 'dissonance' had a meaning which was quite different from those which developed later. It was certainly the prevailing (if not the only) sense of the CDC preceding the rise of polyphony in western music. It is also important to note, however, that this earliest sense of the CDC *still exists* as a musically meaningful concept, even when expressed by different terms. It is clearly the principle behind Rameau's rules for root-progression, as in the following (from the *Treatise on Harmony*, 1722):

## 16. *The pre-polyphonic era (CDC-1)*

...when we give a progression to the part representing the undivided string [i.e. the *basse-fundamentale*], we can only make it proceed by those intervals obtained from the first divisions of the string. *Each sound will consequently harmonize with the sound preceding it* [my emphasis].<sup>37</sup>

It is also manifested in later tonal theory in the notion of “closely related keys” involved in modulation, but its nearest equivalent in the contemporary musical vocabulary is perhaps simply “relations between tones”—in the sense in which this phrase is used by Schoenberg, for example, when he says (in “Problems of Harmony”):

If...we wish to investigate what the relation of tones to each other really is, the first question that arises is: what makes it possible that a second tone should follow a first, a beginning tone?...My answer is that such a juxtaposition of tones...is only possible because a relation already exists between the tones themselves.<sup>38</sup>

Finally, CDC-1 is evidently the basis for Hindemith’s “Series 1” (in the *Craft...*), about which he says:

The values of the relationships established in that series will be the basis for our understanding of the connection of tones and chords, the ordering of harmonic progressions, and accordingly the tonal progress of compositions.<sup>39</sup>

The one essential difference between these “relations between tones” as discussed by Schoenberg and Hindemith and the earlier sense of consonance and dissonance I am calling CDC-1 is that what had originally been conceived as a simple two-fold dichotomy is now conceived as an ordered continuum of degrees of relatedness, within which, as Hindemith says:

We know that no point can be determined at which “consonance” passes over into “dissonance.”<sup>40</sup>

In every other respect, however, the musical/perceptual phenomenon to which Schoenberg and Hindemith were addressing themselves here is equivalent to the most ancient of all known conceptions of consonance and dissonance—CDC-1.

## Section II

### The early-polyphonic period, ca. 900-1300 (CDC-2)

The second sense of the CDC—described earlier as involving an aspect of the sonorous quality of simultaneous dyads, relatively independent of their musical context—begins to be expressed unambiguously in the theoretical literature only after the rise of polyphony in about the 9th century. Although it is obviously difficult to give a precise date to the beginnings of polyphonic practice, the following passage from Hucbald’s early-10-century treatise *De harmonica (Melodic instruction)* has been called “the earliest unmistakable reference to harmonized music”:<sup>41</sup>

“Consonance” [*consonantia*] is the calculated and concordant blending [*concordabilis permixtio*] of two sounds, which will come about only when two simultaneous sounds from different sources combine into a single musical whole, as happens when a man’s and a boy’s voices sound at once, and indeed in what is usually called “making organum”...There are six of these “consonances” [*consonantiae*], three simple and three composite...diapason, diapente, diatessaron, diapason-plus-diapente, diapason-plus-diatessaron, and double diapason.<sup>42</sup>

With the advent of polyphony it had become necessary—for the first time—to make a distinction between melodic interval and simultaneous dyad, and Hucbald’s solution to this problem involved a subtle modification of the traditional Latin terminology associated with plainchant. In his introduction to Warren Babb’s English translation of Hucbald’s treatise, Claude Palisca explains certain differences between Hucbald’s terminology and that of his 6th-century predecessor Boethius:

At the outset Hucbald makes several distinctions among intervals. First he uses the terms *aequisonae* and *consonae*...terms derived from Boethius, who in turn got them from Ptolemy, but Hucbald...altered their meaning. For Boethius two notes of the same pitch are *unisonae*; two notes which sound almost identical, such as the octave and double octave, are *equisonae*; whereas the *diapente* and *diatessaron* are *consonae*. All these together comprise the genus *consonantia* or consonance. For Hucbald *aequisonae* are unisons, *consonae* are simply consonances, and he transfers the condition of agreeably sounding simultaneously, which Boethius ascribed to the octaves, from these to all consonances...Hucbald distinguishes consonance...from melodic interval [*intervallum* or *spatium*]...Ancient theory is thus adjusted to

to the budding practice of polyphony. The Ptolemaic-Boethian concepts are distorted in the process, to be sure, but they are ingeniously fitted to modern use. In the Greek tradition all consonances were essentially melodic intervals...<sup>43</sup>

This shift of referent for *consonantia* from melodic interval to simultaneous dyad did not become standard until much later, however, since it continued to be used in the Boethian sense as melodic interval by the majority of theorists throughout this period—and even well into the 14th century. The word most commonly used then for consonant simultaneous dyad was *concordantia* (or occasionally, *concordia*). Even this “most common” usage was not entirely consistent, however, and Johannes de Grocheo (writing ca. 1300) explicitly reverses these correlations.<sup>44</sup>

Another solution to this problem of distinguishing between melodic interval and simultaneous dyad involved the adaptation of the ancient Greek terms *symphonia* and *diaphonia*, but here the semantic transformations were less subtle. By the 10th century *symphonia* had come to mean a consonant simultaneous dyad, and is used strictly in that sense by theorists as late as Walter Odington and Jacobus of Liege (ca. 1300 and 1330, respectively). The word *diaphonia*, on the other hand, entirely lost its earlier linguistic function as antonym for *symphonia*, and came to mean (by the 11th century, at least) simply singing in separate parts simultaneously—another term for *organum*. In the anonymous *Musica enchiriadis*, written at about the same time (ca. 895) as Hucbald’s treatise, his “consonances” are called “*symphoniae*,” and described as follows:

Not all tones blend together equally well, nor do they always render harmonious effects in song in every kind of combination. Just as letters brought together at random often do not produce either connected words or syllables, so in music only certain fixed intervals may constitute *symphoniae*. A *symphonia* is a pleasant concord [*dulcis concentus*] of dissimilar tones joined to one another... There are three simple or prime *symphoniae*, from which the rest are compounded. Of these one is called a fourth, another, a fifth, and the next, an octave...<sup>45</sup>

Whereas Hucbald’s treatise is primarily concerned with melody, the *Musica enchiriadis* is largely devoted to early *organum*, and might thus be considered the earliest known treatise on what would (much later) come to be called “counterpoint.” It includes what may be the first “rule” in the history of that discipline, designed to avoid the tritone:

Since the sounds at the interval of a fourth do not all, without exception, produce consonances throughout the whole series of tones, certain intervals of the composition should not be sung exactly. Therefore, in this kind of song the voices are marvelously accommodated to each other by a certain rule...<sup>46</sup>

Again, in a long section of the subsequent *Scholia enchiriadis* (ca. 900) entitled “Of Symphonies,” we find the following dialogue:

(Disciple) What is a symphony? (Master) A sweet blending of certain sounds, three of which are simple—diapason, diapente, and diatessaron—and three composite—double diapason, diapason plus diapente, and diapason plus diatessaron.<sup>47</sup>

This is followed by a detailed description of each, including the several “composite” forms—this adjective now referring to various octave-doublings of one or both of the primary tones of the dyad (in the “organal” and “principal” voices). Note that, in all three of these treatises from the late 9th or early 10th century, the same intervals are classified as consonant as those so designated by Aristoxenus over twelve hundred years earlier, but the reference now is clearly to simultaneous dyads rather than successive tones.

In its earliest manifestations then, CDC-2 is nearly indistinguishable from CDC-1, but a growing separation between the two begins to be noticeable in theoretical writings of the 11th and 12th centuries, with CDC-1 implicit in passages concerned solely with melody, CDC-2 in those describing the effects of the added voice or voices in organum. Both senses of the CDC are to be found on the *Micrologus* (ca. 1026-28) by Guido d’Arezzo, as can be seen by comparing the following definition of ‘symphony’ (exemplifying CDC-2);

You should remember that these three intervals [the octave, fifth, and fourth] are called “symphonies,” that is, smooth unions of notes [*suaves vocum copulationes*], because in the diapason the different notes sound as one [*unum sonant*] and because the diapente and the diatessaron are the basis of diaphony, that is, organum, and produce notes similar in every case...<sup>48</sup>

with another passage which occurs during his discussion of modes and melodic organization (and thus exemplifies CDC-1):

Notice... that these affinities of notes [*vocum affinitates*] in the various modes are made through the diatessaron and the diapente, for A is joined to D, and B to E, and C to F by the lower diatessaron, but [also] by the upper diapente. Whatever other affinities there are, they are produced likewise by the diatessaron and the diapente... We have confined ourselves to just a few things about the similarities between notes, because insofar as similarity is sought out between different things, to this extent is lessened that diversity which can prolong the labor of the confused mind.<sup>49</sup>

In a later passage, the two senses of the CDC are both referred to, and Guido notes the close correlation between them:

Diaphony sounds as a separateness of [simultaneous] sounds, which we also call organum, in which notes distinct from each other make dissonance harmoniously and harmonize in the dissonance [*concorditer dissonant, & dissonanter concordant*].<sup>50</sup> Some practice diaphony in such a way that the fourth step down always accompanies the singer, as A with D; and if you double this organum by acute a, so that you have A D a, then A will sound a diatessaron with D and a diapason with a, whereas D will sound a diatessaron and a diapente with A and a respectively, and acute a with the lower two notes a diapente and a diapason. *These three intervals blend in organum congenially and smoothly just as it has been shown above that they caused a resemblance of notes [my emphasis].* Hence they are called “symphonies,” that is, compatible unions of notes, although this term symphony is also applied to all chant. Here is an example of this diaphony [*diaphoniae*].<sup>51</sup>

In other words, tones forming a fourth, fifth, or octave display an “affinity,” “similarity,” or “resemblance” to each other in a melodic context (CDC-1), and they *also* create “smooth,” “congenial,” or “compatible unions” with each other when sounded simultaneously (CDC-2). The same three intervals are thus understood to satisfy two different conditions—but these conditions *are* different.

A few generations later, Guido’s “and” has become an “either/or” in John’s treatise *De musica* (ca. 1100), as we see in the following:

Among other things, one ought to know that there are just nine intervals [*modi*] from which melody is put together...Six of these are called “consonances” [*consonantiae*], either because in singing they sound together—at the same time—more often than the others [CDC-2]; or, *more likely* [my emphasis], because they sound together in the sense that they are related among themselves...[CDC-1].<sup>52</sup>

John seems to prefer the second of the two explanations, probably because he is primarily concerned with melody—and only secondarily with “diaphony,” which receives a very cursory treatment in this work (one chapter out of twenty-seven).

What eventually led to a more clear-cut distinction between CDC-1 and CDC-2 were developments of the freer style of organum involving oblique and contrary (as well as parallel) motion between the voices—and thus a more frequent occurrence of simultaneous dyads other than the three classical “symphonies.” Guido describes one form of this freer style as follows:

...let us explain the low voice added beneath the singer of the original line in the way that we employ. For the above manner of diaphony [parallel organum] is hard [or “harsh”—*durus*], but ours is smooth [*mollis*]. In it we do not admit the semitone or the diapente[!], but we do allow the tone, the ditone, the semiditone, and the diatessaron; and

of these the semiditone holds the lowest rank and the diatessaron the chief one. With these four concords [*concordiis*] the diaphony accompanies the chant.<sup>53</sup>

In John’s treatise, parallel organum is no longer even mentioned, and he recommends contrary motion as the “simplest method”—although he seems to prefer it for reasons other than its simplicity:

Diaphony is the sounding of different but harmonious notes, which is carried on by at least two singers, so that while one holds to the original melody, another may range aptly among other tones, and at each breathing point both may come together on the same note or at the octave...Different musicians practice this differently. The simplest method for it is when the various melodic progressions are borne carefully in mind, so that wherever there is an ascent in the original melody, there is at that point a descent in the organal part and vice versa.<sup>54</sup>

Thus—unlike Guido—John does not limit the acceptable intervals between the organal and principal parts to those within the compass of a fourth. Neither does the anonymous author of *Ad organum faciendum* (late 11th century)—even though his definition of ‘diaphony’ is virtually identical to Guido’s. Here we find the following:

The first note of the organum will either remain conjunct with the cantus at the octave or unison, or disjunct at the fifth or fourth. The middle notes, however, move at the fifth and fourth. Then, when the cantus requires (conjunction with) the organum, a *copulatio*<sup>55</sup> is effected in some way.<sup>56</sup>

A companion treatise from about the same time—the anonymous *Item de organo*<sup>57</sup>—adds major and minor thirds to the list of intervals (*consonantiae*) which may be used as simultaneous dyads in organum—even at the beginning of a phrase, and the *Montpellier organum treatise*<sup>58</sup> includes sixths as well as thirds—although Jay Huff, in his Introduction to *Item de organo*, says that “None of the examples in either the present treatise or the Montpellier have a third (or sixth) for an initial interval, as initial interval is defined in both treatises.”<sup>59</sup> Even so, the relatively high incidence of thirds, at least, in music of this period (the 11th century) is indicated by the following statistical data on the Chartres MS 109 (in Hughes’ “The Birth of Polyphony,” 1954<sup>60</sup>): out of a total of 241 intervals (i.e. simultaneous dyads), there are 67 thirds (28%), 48 fourths (20%), and only 15 fifths (6%).

By the 12th century, thirds—and to a lesser extent, sixths—were beginning to demand recognition, but whether recognized by the theorists as consonant or not, the important point, for our purposes, is that these intervals were now being *heard* more and more often as simultaneous dyads, and this provided an opportunity for comparing their sonorous qualities with those of the traditional “symphonies.” This, in turn, led to efforts by theorists in the 13th century to *classify* the various intervals with respect to their sonorous properties

as simultaneous dyads, and most of the classification systems which began to appear in theoretical treatises now involved much finer qualitative distinctions than had ever been employed in descriptions based on CDC-1. In the *De musica libellus* (Anonymous VII, ca. 1220), the class of “consonances” is divided—apparently for the first time—into three subcategories, as follows:

Let it be observed that the unison, semiditone, ditone, diatessaron, diapente, and diapason are more essential than the other intervals [*species*], for all discant forms one of these consonances [*consonantiarum*] with its tenor. It should be noted that the unison and the diapason are perfect consonances, the ditone and the semiditone imperfect, and the diatessaron and the diapente intermediate.<sup>61</sup>

This classification of the consonances as perfect, intermediate, and imperfect is found again in treatises by John of Garland,<sup>62</sup> Franco of Cologne,<sup>63</sup> and Coussemaker’s Anonymi I,<sup>64</sup> II,<sup>65</sup> and IV<sup>66</sup>—all written during the latter half of the 13th century. In addition, some of these theorists also divided the dissonances into similar subcategories, although here there was somewhat less agreement among them as to the appropriate ranking of certain intervals. Some of the many consonance/dissonance classification-systems expressed or implied by theorists from the beginning of polyphonic theory in the 9th or 10th century through the first half of the 16th century are shown in tabular form in Figure 1. In Figure 2, a few of these are displayed in another way which shows more clearly the changes in status of each interval during this same period. (See Appendix, fig. 1 and 2).

John of Garland’s system of interval-classification is the most elaborate of any theorist of the 13th century, involving the largest number of subcategories (six). In addition, his definitions of “concord” and “discord” are fairly typical of those given by theorists of this period (many of whom borrowed directly from him), and are thus indicative of the qualitative connotations of ‘consonance’ and ‘dissonance’ in CDC-2, as in the following (from *De mensurabili musica*, ca. 1250):

Of the consonances [*consonantiarum*], some are called concords, some discords. Concord [*concordantia*] is when two sounds are joined at the same time so that one can be heard as compatible with the other. Discord [*discordantia*] is the opposite...A perfect concord is when two sounds are joined at the same time so that the ears cannot distinguish one voice from the other on account of [this] concordance, and is called one sound, or the sounding of equals [*equisonantiam*], as in the unison or diapason...An imperfect concord is when two sounds appear at the same time so that the ears can wholly distinguish one voice from the other, and I say that this is [also] a type of concord, and there are two species, namely the ditone and semiditone. An in-between concord is when two voices are joined together so that they are neither perfect nor imperfect, and there are two species, namely the diapente and diatessaron.<sup>67</sup>

The “discords” are similarly subdivided as follows:

When two sounds are joined at the same time so that one sound cannot be heard as compatible with the other, it is called discord. Of the discords, some are called perfect, some imperfect, some in-between. They are called perfect when two sounds are combined by a certain means according to the sympathy [*compassionem*] of sounds so that one voice cannot be heard as compatible with the other, and there are three types, namely the semitone, tritone and ditone with diapente [i.e. major seventh]. They are called imperfect when two sounds are combined so that in a certain manner they can be heard as compatible, but nevertheless not concordant like the concords; and there are two species...the tone with diapente and semiditone with diapente. They are called in-between when two sounds are combined so that they are heard partially like the perfect discords, partially like the imperfect discords, and there are two species...the tone and semitone with diapente.<sup>68</sup>

The definitions of “concord” and “discord” given by Franco, Anonymous I, and Lambertus (“cujusdam Aristotelis,” in Coussemaker’s *Scriptorium*...I)<sup>69</sup> are nearly identical to those of John of Garland, and the classification systems of the first two of these writers differ from John’s only with respect to the dissonances, which they divide into two (rather than three) subcategories, ranking the major second with the “imperfect,” the minor sixth with the “perfect discords.” Unfortunately, the relevant portion of Coussemaker’s text of the *Tractatus de musica* now attributed to Lambertus is garbled, making it impossible to ascertain just how he may have intended to classify each interval, but it is clear that he distinguished the same three degrees of “discord” (as well as of “concord”) as did John of Garland.<sup>70</sup>

The question naturally arises: to what extent did such theoretical systems of interval-classification reflect the actual harmonic practice of their own time, as distinct from purely theoretical doctrines carried over from some earlier era—or even the idiosyncracies of the individual writers? After summarizing the statistical data cited earlier regarding the frequency of occurrence of various simultaneous dyads in the Chartres MS 109, Dom Anselm Hughes says:

The result of this analysis shows that the actual music of the eleventh century at Chartres at any rate was considerably different from what we have been taught to expect from the descriptions of the theorists, and that is, from a later point of view, considerably in advance of it.<sup>71</sup>

His primary reason for saying this is that fifths occur much less frequently—and thirds more frequently—than their relative theoretical status as consonances might lead one to expect, although—as has been suggested by Fred Blum, if Hughes had considered the more “progressive” discussion of thirds and sixths in the Montpellier organum treatise “he might not have found such an immeasurable gap between theory and practice.”<sup>72</sup> Both Hughes and Blum seem

to assume, however, that there should be a simple correlation between interval-frequency and consonant status, which is at least questionable, if not altogether unwarranted. If this criterion were applied to the free organum style described by Guido, for example, the resulting classifications would look very strange indeed—the fifth would be a dissonance along with the semitone, and the thirds and major second would be only slightly less consonant than the fourth (with the major second more consonant than the minor third!). In an Appendix at the end of this section some statistical data are presented regarding dyad-frequencies in Perotin's conductus, *Salvatoris Hodie*, and these are compared with corresponding data given by Hughes in the source quoted above, for music of the 11th-13th centuries. In nearly every case, seconds occur more often than sixths, which suggests that dyad-frequency is determined by other factors (such as a tendency to favor smaller intervals over larger ones)—in addition to consonance and dissonance. But is it not also at least possible that Medieval musicians actually *enjoyed* the sonorities of simultaneous aggregates that even they would have called “dissonant”?—just as is clearly the case with many 20th-century composers. It can be admitted that Hughes' suggestion that harmonic practice was “considerably in advance of” theory is plausible—if only because of the analogous discrepancies between theory and practice which are so painfully evident in our own century. But the new musical experiences of the 20th century have also made it possible for us to hear the magnificent clashes of seconds and sevenths in the *organa* and *conductus* of Perotin, for example, in a more positive way than was perhaps possible for 19th- and early-20th-century musicians and musical scholars, for whom the music of Perotin could only represent a “primitive” or “archaic” stage in a progressive-evolutionary development in which “complete control” of the musical materials was not achieved before Dufay (at the earliest), or—for some—Palestrina, or even J.S. Bach. Such an attitude about the music (and I should add, the theoretical writings) of the 13th century is no longer tenable, of course, but many of the early prejudices linger on.

Harmonic practice differed from one region to another, of course, and the English were apparently somewhat “in advance of” Continental musicians in their use of thirds and sixths. In *De mensuris et discantu* (ca. 1275), Anonymous IV gives the same three-fold classification of the consonances specified by John of Garland, Franco of Cologne, and others, but then adds the following information:

...there are excellent composers of polyphonic music in certain places, such as England...who consider [thirds] to be the best possible consonances [*optime concordantie*], since they use them so much.<sup>73</sup>

Later, in reference to an example he gives of the use of the major sixth as the penultimate dyad before a final octave at the end of a phrase, he says:

Thus, we have shown an example of that vile and loathesome dischord [*vilis discordantia sive tediosa*] which is the sixth, and which is mostly to be avoided. If, however, it is the next-to-last note [in the *duplum*, above the tenor] before a perfect

consonance, which is the octave, it is the best consonance in this arrangement of notes or sounds...<sup>74</sup>

Only a few years later, the English theorist, Walter Odington, in his *De speculatione musicae* (ca. 1300), classifies the fourth, fifth, octave, twelfth, and double octave as *symphoniae*, while the major and minor thirds and tenths, the major (but not the minor) sixth, and the eleventh are called *concordes discordiae*—“discordant concords”—or, in effect, “imperfect consonances.”<sup>75</sup> Regarding the theoretical status of thirds and sixths during this period, Hughes has written:

The intervals of the third and, to a lesser degree, the sixth were now [by the late 13th century] recognized by theorists. As early as the latter half of the twelfth century Theinred of Dover explains why the major and minor thirds are admitted in organa, in spite of the fact that they are not strictly consonances...It is obvious that the reluctance of theorists to admit thirds and sixths as consonances was due to the fact that they did not fit into the acoustic theory which they had inherited from the Greeks...But as Theinred himself says, the difference [between the Pythagorean and “just” forms of these intervals] is hardly noticeable to the ear; and Odington...not only mentions that many people regard the *ditonus* and the *semiditonus* as consonant...but also observes that intervals like this which are not mathematically consonant can be made to sound so if they are skillfully and beautifully sung.<sup>76</sup>

As Hughes suggests here, one of the primary reasons for the long delay in accepting thirds and sixths as consonant was the persistence by theorists in assuming the Pythagorean ratios for these intervals, in spite of what I would consider the very great probability that what was actually being sung—and therefore heard (in vocal music at least)—were their simpler “just” forms. A comparison of the “just” with the Pythagorean ratios for thirds and sixths makes it clear why the theorists (if not the practicing musicians) would have resisted their inclusion among the consonances for so much longer than musical practice would seem to have warranted: 5/4 vs. 81/64 for the major third or ditone, 6/5 vs. 32/27 for the minor third (semiditone), 5/3 vs. 27/16 for the major sixth (tone plus diapente), and 8/5 vs. 128/81 for the minor sixth (semitone plus diapente). Sixty years after Franco's *Ars cantus mensurabilis*, the ratios specified for these intervals by Philippe de Vitry in his *Ars Nova*<sup>77</sup> (ca. 1320) were still those derived from Pythagorean tuning by fourths, fifths, and octaves—and even as late as the end of the 15th century the majority of theorists were steadfastly assigning these Pythagorean ratios to thirds and sixths. It is no wonder then that Franco (and others) included the minor sixth (128/81) among the “perfect discords,” along with the semitone, tritone, and major seventh!

And yet—constrained as they may have been by Pythagorean doctrine—these theorists of the 13th century were *not* simply rank-ordering the intervals in some routinely mechanical way according to the relative complexities of

their Pythagorean ratios—even though this factor is often invoked by them in their discussions of consonance and dissonance. If they had been doing this, their classifications would not have differed, one from another, and thirds and sixths would not have been classified as consonances at all, since their Pythagorean ratios are more complex than those of the major second and minor seventh, both of which were invariably classified as dissonances. This indicates to me that the theorists of this period were making a very real effort to evaluate the sonorous qualities of simultaneous dyads as they *heard* them—i.e. according to how they actually sounded to them in the music—and this *in spite of* Pythagorean doctrine. In this respect, at least, there was an intimate connection between musical theory and practice in the 13th century—a connection which is in no way weakened by the differences which existed between the various systems of interval-classification formulated by individual theorists. These differences invariably involved only certain intervals—namely those in the middle range of the consonance/dissonance “spectrum”—whereas there was no disagreement among them regarding the classification of intervals at either end of that same spectrum. A comparison of the rank-orderings that would be derived from the relative complexities of the Pythagorean ratios, on the one hand, and of the simpler “just” ratios, on the other, shows that it is precisely these intermediate intervals whose relative rank would have been most affected by any variability or ambiguity of intonation in performance (see Figure 3). The probability that there *was* such variability or ambiguity—and, more specifically—that the intonation of these intervals was tending in the direction of the simpler “just” ratios (at least for those used most frequently), is suggested in Figures 4a and 4b, where the rank-orders given by John of Garland and Franco of Cologne (Figure 4a)—and those which would be derived from Pythagorean and “just” ratios (Figure 4b)—have been plotted as a function of interval size (insemitones, along the horizontal axis). It is evident that Figure 4a approximates the graph based on “just” ratios more closely than it does the Pythagorean, for all intervals except perhaps the two sixths. (See Appendix, fig. 3 and 4).

Nevertheless, it was not the “just” but the Pythagorean ratios which were consistently used by Medieval theorists in their discussions of the objective properties of intervals, and the fact that their consonance/dissonance classifications did not simply correspond to the order of complexity of these ratios is ample evidence that their basis for classification was, in fact, some aspect of the perceptible sonorous qualities of simultaneous dyads. The same conclusion (though based perhaps on a different line of reasoning) has been expressed by Richard Crocker (in “Discant, Counterpoint, and Harmony,” 1962) as follows:

Medieval writers...consistently invoke the judgment of the ear in discussing the degree of concord and discord...Clearly...it is false to believe that the Middle Ages relied solely on mathematics and excluded the judgment of the ear in determining the nature of consonance.<sup>78</sup>

In support of this observation, which is, as he says, “in flat contradiction to

the opinion commonly held about medieval musicians,” he quotes statements by several theorists from John of Garland in the mid-13th century to Tinctoris in the late-15th—on the basis of which he further concludes:

These authors say, in sum, that the ear takes pleasure in consonance, and the greater the consonance the greater the pleasure; and that for this reason one should use chiefly consonances in composing discant.<sup>79</sup>

The question arises, however: was the degree of “pleasure” associated with a given dyad the sole (or even the primary) basis for its placement within the consonance/dissonance continuum? Crocker suggests that there must have been “at least two distinct bases for judgment of consonance”—one involving the degree to which the tones of a dyad “blend together,” the other having to do with “the function of intervals within the development of style”<sup>80</sup>—and regarding the first of these he says:

...the medieval musician...finds the simplest intervals to be the sweetest, a judgment which one must admit to have been reasonable in the springtime of polyphony. We, withdrawing a little from sonorous reality, find the more complex, less consonant intervals to be sweeter...<sup>81</sup>

Crocker seems to equate simplicity, sweetness or pleasure, and what he calls “the degree of sonorous blend,” including them all as components of the first of his “two distinct bases for judgment of consonance.” But these are clearly separable factors, and while sweetness and pleasure involve highly subjective responses—and these have obviously changed considerably over the centuries—“sonorous blend” is a rather more objective factor (though entirely *perceptual*). By comparison with some of the definitions of ‘consonance’ and ‘dissonance’ given by theorists *after* the 13th century, those of the 13th century have a remarkably objective—even ascetic—character which suggests that perhaps—for them (as Arthur Koestler said of the early Greeks)—“balance and order, not sweet pleasure,” were still “the law of the world.” Consider again the definitions of “perfect” and “imperfect concord” by John of Garland:

A perfect concord is when two sounds are joined at the same time so that the ears cannot distinguish one voice from the other...and is called one sound, or the sounding of equals.../whereas, with an imperfect concord/...the ears can wholly distinguish one voice from the other...<sup>82</sup>

Taken by itself, John’s definition of “perfect concord” might seem to refer to nothing more than what we now call “octave equivalence”—and this phenomenon is certainly involved here, since he expressly refers to the unison and octave as “one sound, or the sounding of equals” (*equisonantium*, obviously related to the Boethian *equisonae*). But this does not explain the placement of the fourth and fifth in a category immediately adjacent to these “perfect

concorde.” There is no way in which one can say that the tones forming a fourth or a fifth are just a little less “equivalent” than those of a unison or octave: “Octave-equivalence” may well be the reason why the octave (as a simultaneous dyad) manifests a degree of sonorous blend nearly equal in “perfection” to the unison, but I submit that it was *the degree of sonorous blend itself* (or something very closely related to it) that formed the primary basis for dyad classification in the 13th century.

In fact, I will carry this argument one step farther and suggest that what 13th-century theorists may have actually meant by “perfect concord” was a condition in which a simultaneous dyad *sounded like a single tone*, and that they distinguished varying degrees of consonance (and dissonance) according to the extent to which a given dyad satisfied this condition of “singularity.” In support of this hypothesis I invoke the remarkable definition of ‘discant’ given by the last of the great Medieval theorists to write extensively about musical practices and conceptions of the 13th century—Jacobus of Liege. His mammoth *Speculum musicae*, although written (ca. 1330) long after the end of the period associated with CDC-2, is suggestive of what “might of been” if the style he called the ‘*ars antiqua*’ had not been so precipitously terminated and replaced by the new concerns of the ‘*ars nova*.’ And since Franco had said that “every discant is governed by consonances,”<sup>83</sup> I think we can interpret this definition of discant by Jacobus—indirectly at least—as a definition of ‘consonance’:

Discant is called the consonance of distinct melodies because—just as consonance requires distinct sounds mixed together simultaneously—so discant (requires) distinct melodies mixed together simultaneously; and just as not all simultaneously mixed sounds will be heard as smooth and sweet mixtures, so not all distinct melodies mixed together simultaneously will produce discant; but those which concord with each other become, by virtue of their concord, *like one melody [quasi cantus unus]*, although there are many, just as from the distinct sounds of the octave or fifth there is brought about—by virtue of the concord—*one sound, as it were [quasi sonus unus]*. Whoever therefore discords with another does not discant. What discant is, then, (is) nothing but two or more distinct melodies (sounding)—by virtue of the consonance—*as one melody*. To discant is to make two or more distinct melodies—through smooth concord—*like one melody*; or, discant is the making of a melody above the tenor, distinct from it, but because of the smooth mixed sound, *like one melody*. To discant is to perform above the tenor or tenors other sounds at the same time with it, sounds (which are) concordant with it. He discants then who sings sweetly together with another or others, so that from distinct sounds it becomes *like one sound*...<sup>84</sup>

Thus—like a litany—the phrase “*quasi sonus (or cantus) unus*” is repeated over and over again—six times in all—as though Jacobus felt a necessity to display this idea in all of its possible permutations and combinations with the

other elements of discant. And—in retrospect—the definitions of ‘consonance’ and ‘dissonance’ by the earlier polyphonic theorists appear in sharper outline. In fact, the whole development of polyphony during these first centuries of its history is freshly illuminated. It had originally been inspired by a desire to glorify, amplify, or *intensify* the traditional plain-chant—without in any way obscuring or distracting the listener’s attention from the chant itself. In the natural course of its development, polyphonic practice had gradually become more and more elaborate—eventually culminating in the magnificent *organa quadrupla* of Perotin and the School of Notre-Dame in the early 13th century. But during this whole period—and until sometime after the death of Perotin himself—this inspiration was never lost sight of, and the original desire to “intensify” the chant without obscuring it continued to be an essential determinant of polyphonic practice. The fact that music in the second half of the 13th century had already begun to overstep the stylistic boundaries imposed by these criteria is suggested by the notorious Papal decree of 1322, which reads, in part, as follows:

Certain disciples of the new school, much occupying themselves with the measured dividing of the *tempora*, display their prolation in notes which are new to us, preferring to devise methods of their own rather than to continue singing in the old way...Moreover, they truncate the melodies with hoquets, they deprave them with discants, sometimes even they stuff them with upper parts made out of secular songs. So that often they must be losing sight of the fundamental sources of our melodies in the Antiphoner and Gradual, and may thus forget what that is upon which their superstructure is raised...This state of things, hitherto the common one, we and our brethren have regarded as standing in need of correction; and we now hasten therefore to banish those methods, nay rather to cast them entirely away, and to put them to flight more effectually than heretofore, far from the house of God. Wherefore...we straitly command that no one henceforward shall think himself at liberty to attempt those methods, or methods like them, in the aforesaid Offices, and especially in the canonical Hours, or in the solemn celebrations of the Mass...Yet, for all this, it is not our intention to forbid, occasionally—and especially upon feast days or in the solemn celebrations of the Mass and in the aforesaid divine offices—the use of some consonances, for example the eighth, fifth, and fourth, which heighten the beauty of the melody; such intervals therefore may be sung above the plain *cantus ecclesiasticus*, yet so that the integrity of the *cantus* itself may remain intact, and that nothing in the authoritative music be changed...<sup>85</sup>

By the very measures that were used to justify this condemnation of the newer methods, the earlier polyphonic music was evidently deemed to have been of a kind that would “heighten the beauty of the melody” while leaving “intact...the integrity of the *cantus...ecclesiasticus*.”

Music theory in the 9th through 12th centuries had been in a state of flux which was quite without any historical precedent—and this obviously in response to the profound changes that were taking place in musical practice. The avalanche of new procedures, new conceptions—but above all—new *auditory experiences* which must have followed one another in rapid succession during this period suggests a comparison with our own time perhaps more than any other period in the history of western music. A new musical “parameter” had come into existence—in addition to the parameters pitch and time, which were the primary dimensions of monophonic music. This had created a need to organize the perceptually distinct “values” in this new parameter—to devise a *scale* of such values analogous to the scale of pitches—just as the necessity for the rhythmic coordination of several polyphonic parts had created a need to organize different time values, and for a rhythmic notation to represent them. Both of these needs were finally satisfied in the 13th century by the formulation of the system of rhythmic modes, on the one hand, and on the other, the development of systems of classification of simultaneous dyads with respect to consonance and dissonance.

As it turned out, the period of relative stability which might have been initiated by these theoretical solutions was not destined to last very long. Already in Franco's *Ars cantus mensurabilis* certain modifications of modal rhythmic theory are evident, and later developments of the *ars nova* and other styles in the 14th century eventually yielded a new system of interval-classification which was radically different from that of the 13th century.<sup>86</sup> The conception of consonance and dissonance implicit in this new classification system will be called CDC-3, and will be the subject of the next Section of this book. But before moving on, it is important to note that—just as was the case with CDC-1—CDC-2 still CDC-1 exists as a musically meaningful concept. It is often confused with other senses of the CDC which developed later, but it is to be found in a relatively pure form in the concept of “tonal fusion” (*Tonverschmelzung*) enunciated by the 19th-century theorist Carl Stumpf, as expressed, for example, in the following passage from his article “Konsonanz und Dissonanz” (1898):

The combined sound of two tones approximates—now more, now less—the impression of a single tone, and it appears that the more this condition holds, the more consonant is the interval. Even when we perceive and distinguish the tones as two, they nevertheless form a whole in perception, and this whole strikes us as more or less unitary. We find this property with simple tones, just as with those with overtones. That the octave sounds effectively like a unison, even when we can clearly distinguish two tones in it, is always admitted, although it is nothing less than self-evident, but it is a most remarkable fact. This same property becomes weaker, however, even with fifths and fourths, and still weaker with thirds and sixths... That is the rock, discarded by the builders, which we make the cornerstone.<sup>87</sup>

A comparison of this passage with the definition of *discantus* given by Jacobus

of Liège p. 28 will show that the meaning of ‘consonance’ implicit there (*quasi sonus unus*) was virtually identical to the meaning suggested here by Stumpf.

Stumpf makes a very clear distinction between the consonance or dissonance of successive vs. simultaneous tones (and thus between what I am calling CDC-1 and CDC-2), attributing the former (with Helmholtz) to the coincidence of upper partials (“*Zusammenfallen von Theiltönen*”), as the physical basis for tone-relations (“*Tonverhältniss*”) or relationships (“*Verwandtschaften*”). But even in his consideration of simultaneous tones, discrepancies naturally arose between the results of his psychological experiments on fusion and those of other forms of the CDC which will be seen (in subsequent Sections of this book) to have emerged later. Some years after this work on fusion, as Norman Cazden tells it:

...Stumpf came to believe that as soon as combinations of more than two tones are involved, a new and different level of musical response arises on which operate the more complex relationships among chords. Thus he regarded “Konsonanz” and “Dissonanz” less as *fundamental* than as merely *elementary* values with little direct bearing on the art of music, while the practice of musical harmony was seen to involve the motion of chords, chord progressions, rather than two-tone intervals of theoretical purity judged in isolation. Appropriate to such a higher level of chord action, new laws arise, which are best deduced from the observation of actual harmonic practice in music, and which cannot be accounted for by the raw properties of consonant agreement. For the sake of clarity, Stumpf proposed that the terms *Concordance* and *Discordance* be applied to the qualities perceived on this level of functional harmony.<sup>88</sup>

Stumpf's later distinctions between ‘consonance’ and ‘dissonance’ (and between ‘dissonance’ and ‘discordance’) would roughly correspond to the distinctions I will make later (Part III) between CDC-2 and what will be called CDC-4, but the historical and aesthetic implications he apparently attached to these distinctions were very different from those I will draw from them. Perhaps if Stumpf had been prepared to limit the application of his concept of fusion to the early-polyphonic period—during which it was, in fact, the prevailing musical conception of consonance and dissonance—he would not have had to relegate “fusion” to a position so unimportant as to be “merely elementary...with little direct bearing on the art of music.”

## NOTES—Part One: Section I

1. An indication of the currently equivocal status of *consonance* and *dissonance* is the conspicuous absence of entries for either of these terms in the otherwise very comprehensive *Dictionary of Contemporary Music*, edited by John Vinton (New York: Dutton, 1971).
2. *The Oxford English Dictionary* (London: Oxford University Press, 1933), rep. 1961), Vol. II, p. 866 and Vol. III, p. 515.
3. *Webster's Third International Dictionary* (Springfield, Massachusetts: G. & C. Merriam Co., 1971), pp. 484 and 657.
4. John Backus, *The Acoustical Foundations of Music* (New York: Norton, 1969), p. 116.
5. Leo Kraft, *Gradus* (New York: 1976), Book I, p. 29.
6. Willi Apel, *Harvard Dictionary of Music* (Cambridge, Massachusetts: Harvard University Press, 1953), p. 180.
7. Regarding these pleasant/unpleasant connotations of *consonance* and *dissonance*, Apel adds, later in the same *Harvard Dictionary* article: "In spite of numerous efforts no wholly satisfactory explanation and definition of consonance and dissonance has yet been found. The shortcoming of the explanation [quoted] lies not so much in the fact that it is based entirely on subjective impressions, but...in its failure to account for the consonant quality of the fourth and fifth...It is chiefly for this reason that the 'pleasant-unpleasant-theory' cannot be considered satisfactory."
8. Paul Hindemith, *Craft of Musical Composition*, Vol. I, translated by Arthur Mendel (New York: Schott Music, 1937), p. 85.
10. Arnold Schoenberg, *Style and Idea*, edited by Leonard Stein (New York: St. Martin's Press, 1975), pp. 282-3.
11. *Ibid.*, pp. 260-61.
12. Igor Stravinsky, *Poetics of Music*, translated by Arthur Knodel and Ingolf Dahl (Cambridge, Massachusetts: Harvard University Press, 1942), p. 34.
13. Knud Jeppesen, *The Style of Palestrina and the Dissonance* (London: Oxford University Press, 1946, and New York: Dover, 1970), p. 131.
14. Arthur Koestler, *The Sleepwalkers* (New York: Grosset & Dunlap, 1959), p. 29.
15. E. de Coussemaker, *Histoire de l'Harmonie au Moyen Age* (Paris: 1852, rep. Hildesheim: Georg Olms, 1966), pp. 2-3: "Le mot 'harmonie'...signifiait chez les Grecs l'arrangement ou l'enchaînement des sons considérés sous le rapport mélodique de leur acuité ou de leur gravité. Ce n'était point le mélange de plusieurs sons frappant l'oreille en même temps...Nous ne prétendons pas dire par là que la musique à sons simultanés soit exclue des traités grecs sur la musique, ou qu'il n'y soit question que de mélodie; on y trouve en effet plus d'un passage où il est parlé de ce que nous appelons 'harmonie'. Nous voulons seulement démontrer que le mot 'harmonie' n'avait pas chez les Grecs la signification restrictive qu'il a aujourd'hui, et qu'on serait dans l'erreur si on le perniait dans ce sens."
16. J. A. Philip, *Pythagoras and the Pythagoreans* (Toronto: University of Toronto Press, 1966), pp. 123-24.
17. Aristoxenus, *The Harmonics*, edited with translation, notes, introduction, and index of words by Henry Stewart Macran, Oxford, 1902 (Hildesheim: Georg Olms, 1974), p. 165.
18. *Ibid.*, p. 188

19. *The New Oxford History of Music*, Vol. I, edited by Egon Wellesz (London: Oxford University Press, 1957), pp. 340-41.
20. Gustave Reese, *Music in the Middle Ages* (New York: Norton, 1940), p. 250.
21. Aristoxenus, *op. cit.*, p. 205.
22. Aristoxenus, *op. cit.*, p. 198.
23. *Ibid.*, pp. 188-9.
24. *Ibid.*, p. 206.
25. For an excellent and very detailed survey of Pythagorean mathematical/musical concepts see Richard Crocker's "Pythagorean Mathematics and Music," *Journal of Aesthetics and Art Criticism*, Vol. 22 (1963-64), pp. 189-198 and 325-335.
26. Theon of Smyrna, *Mathematics Useful for Understanding Plato* (2nd. c., A.D.), translated by Robert and Deborah Lawlor from the 1892 Greek/French edition of J. Dupuis, edited and annotated by Christos Toulis (San Diego: Wizards Bookshelf, 1979), p. 62.
27. G.S. Kirk and J.E. Raven, *The Presocratic Philosophers* (London: Cambridge University Press, 1957), pp. 236-7.
28. Theon subdivides the consonant intervals into "antiphonic" (octave and double octave) and "paraphonic" (fifth and fourth), and Gaudentius also refers to "paraphonic" intervals (the ditone and tritone) as "intermediate between consonance and dissonance" (see Theon of Smyrna, *op. cit.*, pp. 33-4, and Ruth Halle Rowen, *Music Through Sources and Documents* (Englewood Cliffs, N.J.: Prentice-Hall, 1979), pp. 24-5).
29. Oliver Strunk, *Source Readings in Music History* (New York: Norton, 1950), p. 38.
30. *Ibid.*
31. Theon of Smyrna, *op. cit.*, pp. 33-5.
32. Rowen, *loc. cit.*
33. Strunk, *op. cit.*, p. 89.
34. Curt Sachs, *The Rise of Music in the Ancient World* (New York: Norton, 1943), p. 258.
35. I have not yet found access to the 16th-century *De institutione musica* by Boethius, which Gustave Reese has called "...possibly the most influential treatise in the history of music" (*Fourscore Classics of Music Literature*, 1957 (New York: Da Capo, 1970), p. 12). This leaves a rather profound gap in my documentation of source materials from the early-Medieval period, but I doubt that this will affect the general conclusions of this book in any essential way.
36. *The New Oxford History of Music*, Vol. II, edited by Dom Anselm Hughes (London: Oxford University Press, 1954), pp. 270-71.
37. Jean-Philippe Rameau, *Treatise on Harmony* (1722), translated by Philip Grosset (New York: Dover, 1971), p. 60.
38. Arnold Schoenberg, *op. cit.*, p. 270.
39. Paul Hindemith, *op. cit.*, p. 56.
40. *Ibid.*, p. 85.

## (NOTES: Section II)

41. Hughes, *op. cit.*, p. 276.
42. Warren Babb, translator, *Hucbald, Guido and John on Music*, edited, with introductions, by Claude V. Palisca (New Haven and London: Yale University Press, 1978), p. 19.
43. *Ibid.*, p. 5.
44. Johannes de Grocheo, *Concerning Music (De musica)*, translated by Albert Seay

- (Colorado Springs: Colorado College Music Press, 1967, 2nd edition, 1974), p. 4. The original Latin text may be found in Ernst Rohloff, *Die Quellenhandschriften zum Musiktraktat des Johannes de Grocheio* (Leipzig: VEB Deutscher Verlag, 1943). The relevant passage reads as follows: "The principles of music are normally called consonances and concords [*consonantiae et concordantiae*]. I say *concord* whenever one sound is harmonically continued by another, just as one moment of time or a motion is continuous with another. I say *consonance* whenever two or many sounds give one perfect harmony, united at the same moment and at the same time... First, one must discuss consonances, for it is through consonances that concords are found."
45. Rowen, *op. cit.*, p. 75 (original Latin text in Martin Gerbert, *Scriptores Ecclesiastici De Musica Sacra Potissimum* (hereafter abbreviated GerS), 3 vols. (St. Blasien, 1784; reprint, Hildesheim: Georg Olms, 1963), Vol. I, p. 160).
46. Rowen, *op. cit.*, p. 77.
47. Strunk, *op. cit.*, p. 126.
48. Babb, *op. cit.*, p. 63 (see also GerS II, p. 7).
49. *Ibid.*, pp. 63-65 (and GerS II, pp. 8-9).
50. More literally translated by Palisca in his introduction: "notes disjoined from each other both concordantly dissonating and dissonantly concurring"—and aptly described by him as "Guido's elegant antithesis" (*ibid.*, p. 54).
51. *Ibid.*, p. 77 (and GerS II, p. 21).
52. *Ibid.*, pp. 110-111 (and GerS II, p. 237).
53. *Ibid.*, p. 78 (and GerS II, p. 21).
54. *Ibid.*, pp. 159-60.
55. The *copulatio* was a kind of cadence formula involving the last two dyads in a phrase, the final one always being either a unison or an octave.
56. Jay A. Huff, translator, *Ad Organum Faciendum & Item de Organo* (Brooklyn: The Institute of Mediaeval Music, (n.d.)), p. 42.
57. *Ibid.*, p. 60.
58. Fred Blum, "Another Look at the Montpellier Organum Treatise," *Musica Disciplina*, Vol. 13 (1959), pp. 15-24 (includes both the Latin text and an English translation).
59. Huff, *op. cit.*, p. 37, footnote\*\*.
60. Hughes, *op. cit.*, pp. 282-4.
61. Janet Knapp, "Two 13th Century Treatises on Modal Rhythm and the Discant" (including English translations of *Discantus positio vulgaris* and *De musica libellus*), *Journal of Music Theory*, Vol. 6 (1962), pp. 200-215.
62. Johannes de Garlandia, *Concerning Measured Music (De mensurabili musica)*, translated by Stanley H. Birnbaum (Colorado Springs: Colorado College Music Press, 1978), pp. 15-17 (original Latin text in E. de Coussemaker, *Scriptorum de Musica Medii Aevi* (hereafter abbreviated *CouS*), 4 vols. (Paris, 1864; reprint, Hildesheim: Georg Olms, 1963), Vol. I, pp. 104-6).
63. Franco of Cologne, *Ars cantus mensurabilis*, English translation in Strunk, *op. cit.*, pp. 139-159 (see also *CouS I*, pp. 117-135).
64. Anonymous I, "tractatus de consonantiis musicalibus," in *CouS I*, pp. 296-302.
65. Albert Seay, translator, *Anonymous II: Tractatus de Discantu* (Colorado Springs: Colorado College Music Press, 1978); (includes the Latin text).
66. Luther Dittmer, translator *Anonymous IV* (Brooklyn: The Institute of Mediaeval Music, 1959); original text in *CouS I*, pp. 327-365.
67. Johannes de Garlandia, *op. cit.*, pp. 15-16.
68. *Ibid.*, pp. 17-18.
69. *CouS I*, pp. 251-281.
70. Not only is the text in *CouS I* internally inconsistent; it differs from Coussemaker's own quotations from it in his earlier *Histoire*... cited above (footnote 15).

71. Hughes, *op. cit.*, p. 285.
72. Blum, *op. cit.*, p. 20.
73. Dittmer, *op. cit.*, p. 63.
74. *Ibid.*, p. 64.
75. Walter Odington, *De Speculatione Musicae*, edited by Frederick F. Hammond (Stuttgart: American Institute of Musicology, 1970), pp. 74-75.
76. Hughes, *op. cit.*, pp. 339-40.
77. Leon Platinga, "Philippe de Vitry's Ars Nova: A Translation," *Journal of Music Theory*, Vol. 2 (1961), pp. 204-223.
78. Richard Crocker, "Discant, Counterpoint, and Harmony," *Journal of the American Musicological Society*, Vol. 15 (1962), pp. 1-21.
79. *Ibid.*, p. 4.
80. *Ibid.*, p. 5.
81. *Ibid.*
82. *Vide supra*, p. 28.
83. Strunk, *op. cit.*, p. 152.
84. Jacobus Leodiensis, *Speculum musicae*, Book VII, Ch. IV ("Quid sit discantus"), in *CouS II*, p. 387: "Dicitur discantus consonantia distinctorum cantuum, quia sicut consonantia requirit distinctas voces simul mixtas, sic discantus distinctos cantus simul mixtos; et sicut non quicumque soni simul mixti faciunt mixtionem suaviter dulciterque auditui se facientem, sic nec omnes distincti cantus simul mixti discantum faciunt; sed illi qui invicem concordat ut per bonam illorum concordiam ex illis fiat, quasi cantus unus, cum sint plures sicut ex distinctis vocibus ipsius dyapason vel dyapente propter bonam concordiam efficitur quasi sonus unus. Qui ergo cum alio discordat, non discantat. Quid est igitur discantus nisi duorum cantuum vel plurium distinctorum propter bonam concordiam quasi cantus unus. Discantare est de duobus vel pluribus distinctis cantibus propter suavem concordiam quasi cantum unum facere; vel discantus est supra tenorem cantus factus ab illo distinctus, sed propter suavem vocum mixtionem quasi cantus unus. Discantare est supra tenorem vel tenores voces alias simul cum illis proferre voces illis concordantes. Discantat igitur qui simul cum uno vel pluribus dulciter cantat, ut ex distinctis sonis quasi unus fiat..."
85. Both the original Latin text and an English translation are to be found in H.E. Wooldridge, *The Oxford History of Music*, Vol. I, 2nd edition, revised by Percy C. Buck (London: Oxford University Press, 1929; reprint, New York: Cooper Square Publishers, 1973), pp. 294-6.
86. It is interesting to note in this regard that the major theorist-spokesmen for the *ars nova*—Philippe de Vitry and Jean de Muris—were so exclusively concerned with rhythmic organization and notation that they do not deal with the question of consonance/dissonance classification at all (at least in the works definitely attributed to them).
87. Carl Stumpf, "Konsonanz und Dissonanz," *Beiträge zur Akustik und Musikwissenschaft*, 1 (Leipzig: Johann Ambrosius Barth, 1898), p. 35: "Der Zusammenklang zweier Töne nähert sich bald mehr, bald weniger dem Eindruck eines Tones, und es zeigt sich, dass dies um so mehr der Fall ist, je konsonanter das Intervall ist. Auch dann, wenn wir die Töne als zwei erkennen und auseinanderhalten, bilden sie doch ein Ganzes in der Empfindung, und dieses Ganze erscheint uns bald mehr, bald weniger einheitlich. Wir finden diese Eigenschaft bei einfachen Tönen ebenso wie bei Klängen mit Obertönen. Dass die Oktave dem wirklichen Unisono ähnlich klingt, auch wenn wir deutlich zwei Töne darin unterscheiden können, ist allezeit anerkannt worden, obschon es nichts weniger als selbstverständlich, sondern eine höchst merkwürdige Thatsache ist. Dieselbe Eigenschaft kehrt aber in abgeschwächter Weise auch bei Quinten und Quartan, ja bei Terzen und Sexten wieder. Das ist der Stein, den die Bauleute verworfen haben, den wir zum Eckstein machen."
88. Norman Cazden, "The Definition of Consonance and Dissonance," unpublished, 1975, p. 8.

## **Part Two**

**From the “Ars Nova” through the  
“Seconda Pratica”**

### Section III

#### The contrapuntal and figured-bass periods, ca. 1300-1700 (CDC-3).

The new system of interval-classification which emerged in theoretical writings sometime during the 14th century differs from those of the 13th century in several ways, but the most striking of these differences is that the number of consonance/dissonance categories has been reduced from five or six to just three—"perfect consonances," "imperfect consonances," and "dissonances." Both the major and the minor sixth (as well as the thirds) are now accepted as consonances (albeit "imperfect" ones), the fifth has been elevated from an intermediate to a perfect consonance whereas the fourth has become a special kind of dissonance (or rather, a highly qualified consonance). All of the other intervals—if allowed at all in the music—are simply called "dissonances." There is a virtually unanimous consensus among theorists of the 14th through 17th centuries regarding this system of classification—and it is, in fact, essentially identical to that still used in current textbooks on counterpoint and harmony. The efforts to distinguish and classify finer shades of relative consonance and dissonance are now seen to have been a uniquely 13th-century phenomenon.

How we interpret this reduction in the number of categories in the theoretical interval-classification systems is crucial to an understanding of the later history of the CDC. Obviously, it should not be taken to mean that post-13th-century theorists' power of discrimination had become less acute than those of their 13th-century counterparts, so that the finer distinctions observed by John of Garland or Franco of Cologne were no longer perceptible to them. Not can it mean that their powers of discrimination had become *more* acute, leading to a classification system that was in some way more "accurate" than those of the 13th century. What had changed was not the theorists' powers of discrimination at all, but simply their *criteria* for consonance/dissonance classification, and these were now related to the newly developing *rules of counterpoint*. In CDC-3, all dissonant intervals are subsumed in one undifferentiated category because they are all *treated the same way* in these rules. The intermediate category of consonances has been dropped, but the other two have been retained because the rules *differ* for the treatment of perfect vs. imperfect consonances regarding cadences and consecutive dyads in parallel motion. There is thus established a precise, one-to-one correspondence between the rules of counterpoint and the consonance/dissonance categories referred to by those rules—"consonance" and "dissonance" are now defined *operationally*, according to the intended functional behavior of the various dyads in the music.

This had not been the case in 13th-century theoretical writings. The finer distinctions between varying degrees of consonance and dissonance made by 13th-century theorists were not "operational" distinctions at all, since the rules articulated by them regarding the way different dyads were to be used in composition merely assumed a distinction between the two broad categories of consonance and dissonance; consonances (of any kind) could be used freely, while dissonances (of any kind) were to be used only under certain conditions— as in the following statements by Franco:

The discant begins either in unison with the tenor...or at the diapason [or one of the other "concordances"]... proceeding

then by concords, so that when the tenor ascends the discant descends, and vice versa... Be it also understood that in all the [rhythmic] modes concords are always to be used at the beginning of a perfection, whether this beginning be a long, a breve, or a semibreve... He who shall wish to construct a triplum ought to have the tenor and discant in mind, so that if the triplum be discordant with the tenor, it will not be discordant with the discant, and vice versa. And let him proceed further by concords, ascending or descending now with the tenor, now with the discant, so that this triplum is not always with either one alone... He who shall wish to construct a quadruplum or quintuplum ought to have in mind the melodies already written, so that if it be discordant with one, it will be in concord with the others. Nor ought it always to ascend or descend with any one of these, but now with the tenor, now with the discant, and so forth.<sup>1</sup>

By the mid-14th century there had occurred a clear shift of theoretical concern from the sonorous qualities of simultaneous aggregates to the ways in which their various qualities might be (or rather, *were* being) used in music—and with that, to a strictly operational correspondence between their interval-classification and the rules of what was now being called “counterpoint.” Regarding these rules themselves, there was somewhat less of a consensus among theorists than there was in their interval-classifications, but during the 15th and early 16th centuries most theorists did seem to agree on the following: (1) a piece should begin with a perfect consonance, and (2) it should also end with a perfect consonance; (3) consecutive parallel perfect consonances of the same kind were to be avoided, whereas (4) such consecutive imperfect consonances might be used freely; (5) dissonances were not to be used in note-against-note textures at all, although—in “florid” or “diminished” counterpoint—they were allowed in unstressed rhythmic positions and shorter note-values; and (6) stepwise and contrary motion were preferred, if not absolutely required (this last rule—or pair of rules—was carried over from an earlier period, and is often not stated explicitly, though it generally seems to be assumed). Toward the end of the 15th century, in the writings of Tinctoris and Gafurius, we see the first of these rules begin to break down—imperfect consonances are allowed at the beginning in certain special cases, or the rule simply becomes discretionary. Around the same time, the second rule becomes less frequently observed in practice, as composers began using the third more often in their final chords, but theoretical recognition of this change in musical practice was not immediate.

The third and fourth rules listed above manifest a new and distinctive feature of CDC-3—it has begun to be *contextual*, in the sense that the occurrence of a given dyad at a particular point in the musical fabric is determined by context in a much more specific way than ever before. That is, its occurrence is determined by the *immediately preceding* dyad. If this was a perfect consonance, then the new dyad can only be an imperfect consonance or a perfect consonance of a different type; if it was an imperfect consonance, the new dyad might either be another imperfect consonance or (if several of these had already been used, consecutively) the nearest perfect consonance. The effect

of such constraints is a textural *continuity* which is a hallmark of Renaissance polyphony—and a manifestation of aesthetic/stylistic intentions which were distinctly different from those which had shaped pre-14th-century music.

It seems only natural to assume that the consonance/dissonance categories referred to by the rules of counterpoint had already been determined by considerations of sonorous quality—in the sense of CDC-2—in spite of the reduction in the number of categories involved. With the singular exception of the perfect fourth, this appears to have been true—and that is certainly how the theorists themselves generally represent the situation. The inclusion of major and minor sixths among the consonances of CDC-3 can easily be understood simply as a continuation of a process which had already begun during the early-polyphonic period whereby—as Richard Crocker has phrased it—“the dividing line between concord and discord” had gradually moved “further down the continuum to include more complex intervals as concords.”<sup>2</sup> But the close correlation between the *categories* of consonance and dissonance, on the one hand, and the *rules* regarding their use, on the other, might suggest the possibility of reversing this relation. That is, one could almost say that an interval is a perfect consonance *if* (and only *if*) it may begin and end a piece but may not be used in consecutive parallel motion; that any interval which *may* occur several times in succession is—for that very reason—an imperfect consonance; and that a dissonance is simply any interval which may occur only in a weak rhythmic position, in short note-values, etc. That such a reversal is conceivable is indicated by the fact that Thomas Morley found it necessary, in 1597, to argue *against* such a proposition. Thus, he says:

...if any man would ask me a reason why some of those consonants which we use are called perfect and other some imperfect I can give him no reason, except that our age hath termed those consonants perfect which have been in continual use since music began; the others they term imperfect because they leave (in the mind of the skillful hearer) a desire of coming to a perfect chord; and it is a ridiculous reason which some have given that these be imperfect chords because you may not begin nor end upon them [my emphasis]; but if one should ask why you may not begin nor end upon them I see no reason which might be given except this, that they be imperfect chords... And if the custom of musicians should suffer it to come in practice to begin and end upon them should they then become perfect chords? No verily...<sup>3</sup>

Of course, precisely that thing which Morley imagined could never happen did indeed “come in practice”—and not long after the above was written. The triad containing both fifth and third came to be called “perfect” (although the third by itself continued to be classified as “imperfect”), and this partly because the triad had become an aggregate which every piece of music might “begin and end upon.”

Nevertheless, the vast majority of theoretical writings during this period make

it quite clear that—although the functional behavior of a given dyad may have determined its consonance/dissonance classification, it was some aspect of the sonorous quality of that dyad which originally determined its functional behavior. Thus, regarding the new rule which required every composition to begin and end with a perfect consonance (i.e. a unison, octave, or fifth), Prosdocimus de Beldemandis says (in the *Tractatus de contrapuncto*, 1412):

And here is the reason why. If the listener has been disturbed by the harmonies in the course of the counterpoint, at the end he must be inspired with harmonies more dulcet and amicable by nature, the perfect consonances named above...I mean that the listener himself should be moved by harmony that is agreeable and sweeter by nature. Surely, the spirit of the listener must be affected by the introductory sweet consonance, by the strict consonance of the final, and by the harmonies between, for he is lured on by enjoyment and pleasure.<sup>4</sup>

The adjectives used here as synonyms for 'consonant'—"dulcet," "amicable," "agreeable," "sweet"—obviously describe *quality*, rather than functional behavior, and they carry strong affective connotations which are typical of those expressed or implied by theorists throughout this whole period—and even more consistently and emphatically so than by their 13th-century predecessors. Tinctoris, for example, in his *Dictionary of Musical Terms* (1475), defines 'consonance' (*concordantia*) as "a blending of different pitches which strikes pleasantly on the ear," while 'dissonance' (*discordantia*) is "a combination of different sounds which by nature is displeasing to the ears."<sup>5</sup> Again, in his *The Art of Counterpoint* (1477), "concord" is described as "the mixture of two pitches, sounding sweetly to our ears by its natural virtue,"<sup>6</sup> and "discord" as "a mixture of two pitches naturally offending the ears."<sup>7</sup> In the same work, the "art of counterpoint" itself is defined as follows:

Counterpoint...is a moderate and reasonable concord made by placement of one pitch against another...Hence, all counterpoint is made from a mixture of pitches. This mixture may sound either sweetly to the ears, and this is a concord, or it may sound dissonantly, and this is a discord...<sup>8</sup>

By the mid-16th century ambivalence with regard to these connotations is detectable in the writings of the more perceptive theorists. Zarlino, in *The Art of Counterpoint* (1558), describes the perfect consonances as "less agreeable than the other, less perfect consonances,"<sup>9</sup> and analyzes "The Musical Value of the Dissonant Intervals" (Chapter 17) as follows:

...intervals that are dissonant produce a sound that is disagreeable to the ear and render a composition harsh and without any sweetness. Yet it is impossible to move from one consonance to another...without the means and aid of these intervals...<sup>10</sup>

and in a later chapter (27) he adds the following:

...every composition, counterpoint, or harmony is composed principally of consonances. Nevertheless, for greater beauty and charm dissonances are used, incidentally and secondarily. Although these dissonances are not pleasing in isolation, when they are properly placed according to the precepts to be given, the ear not only endures them but derives great pleasure and delight from them...<sup>11</sup>

In spite of any such ambivalence, however, the pleasant/unpleasant connotations of 'consonance' and 'dissonance' persisted in the writings of theorists long after Zarlino. In the dialogue between teacher and student in Morley's *A Plain and Easy Introduction*..., we find the following:

PHILOMATHES: What is a concord?

MASTER: It is a mixed sound compact of divers voices, entering with delight in the ear...

PHILOMATHES: What is a discord?

MASTER: It is a mixed sound compact of divers sounds naturally offending the ear...<sup>12</sup>

These definitions are nearly identical to those given by Tinctoris over a hundred years earlier—as are the following by Rameau, written more than a century later (in 1722):

CONSONANCE...This is an interval the union of whose sounds is very pleasing to the ear.<sup>13</sup>

DISSONANCE...Thus is the name for intervals which, so to speak, offend the ear.<sup>14</sup>

and Rameau was not unique among 18th-century theorists in this respect, since—according to Krehbiel (1964)—most of the theorists of that century "imply a synonymy between the terms 'consonance' and 'agreeability'; 'dissonance' and 'disagreeability'."<sup>15</sup> By the late 19th or early 20th century, of course, these connotations had become less and less prevalent, and for many composers the earlier associations had even been reversed. This should not, however, cause us to forget the fact (as some recent theorists seem to have done<sup>16</sup>) that these *were* the prevailing affective connotations of 'consonance' and 'dissonance' in western culture for a thousand years or more.

I stated earlier that although the functional behavior of a given dyad may have determined its consonance/dissonance classification in CDC-3, it was some aspect of the sonorous quality of that dyad which originally determined its functional behavior. The only apparent exception to this—and the only unstable element in the new interval-classification system which emerged in the 14th century—was the perfect fourth. Its peculiar status during this period might be

described as follows: as the lowest interval in an aggregate (or as the only interval in a two-part texture) it was to be treated *like* a dissonance—even though it was (in some other sense) a consonance! This curious situation with regard to the fourth is the most puzzling and problematical aspect of the new classification system in CDC-3—and yet one of the most significant. In pre-9th-century sources it had generally been regarded as the *first* of the three basic consonances (or “symphonies”—although perhaps merely because it is the smallest, as noted earlier in the writings of Aristoxenus). In the 13th century it had been an intermediate consonance, equal in status to the perfect fifth. Now we find it either omitted from the list of consonances, assigned to some special class of its own somewhere between consonance and dissonance, or explicitly listed among the dissonances. The history of this change was not, however, a straightforward or gradual decline in status from consonant to dissonant, and the fourth continued to be a source of disagreement among theorists as late as the 18th and 19th centuries. In fact—as Richard Crocker has expressed it—“the anomaly of the fourth is so deep-seated that according to latest reports the issue is still in doubt.”<sup>17</sup>

Gustave Reese has suggested that the fourth had “already lost ground” in musical practice as early as the 13th century.<sup>18</sup> This suggestion is confirmed by the statistics on dyad-frequencies given in the Appendix to Section II. In Perotin’s *Salvatoris Hodie*, for example, the fourth occurs as the lowest interval (or alone) in only 16% of all vertical aggregates, compared to 29% for the fifth and 24% for thirds, but more than half of these (occurrences of the fourth) are “passing” in character, involving note-durations of an eighth or less (in the transcription by Ethel Thurston<sup>19</sup>), and not occurring at the beginning of a rhythmic group (a “perfection”). If only those vertical aggregates are considered which occur at the beginning of a rhythmic group, the figures are 12% for the fourth, 38% for the fifth, and 22% for the thirds. Furthermore, out of 21 “cadences” (i.e. phrases ending with a dotted quarter-note followed by a dotted quarter rest), 6 are open fifths, 12 involve the fifth plus the octave (both reckoned above the lower voice), 1 is simply an unmediated octave, and 2 are what we would now call major triads (in root position). None of these 21 cadences contains a fourth above the lowest voice.

This “loss of ground” of the fourth only began to be reflected in theoretical writings, however, in the 14th century—and then only by the fact that it is simply omitted from the list of intervals allowed in two-part counterpoint (or “discant”). It does not appear to have been explicitly classified as a dissonance until the early 15th century—as in the *Tractatus de contrapuncto* (1412) by Prosdocimus de Beldemandis, where no explanation is offered for the fourth’s mysterious fall from grace, although he qualifies its dissonant status somewhat, as follows:

...because the fourth and its equivalents are less dissonant than other dissonant combinations, they hold an intermediate position between the real consonances and dissonances, so much so that—as some say—they were numbered among the consonances by the ancients.<sup>19</sup>

At one point in Tinctoris’s *The Art of Counterpoint* (1477) the fourth is listed among the “perfect concords,”<sup>20</sup> but in a later passage he calls it “an intolerable discord,” to be treated as a dissonance in two-part textures, or as the lowest interval in music in three or more parts.<sup>21</sup>

In three-part textures, of course, the fourth was considered consonant when it was the upper interval of a 3-note chord whose outer pitches formed a sixth (as in *fauxbourdon*) or an octave (as in most final chords). These conditions were described by Gafurius in the chapter of his *Practica musicae* (1496) which bears the interesting title “The Agreeable Sweetness of the Fourth,” as follows:

...the diatessaron consonance is permitted in two places in counterpoint. First, when a tenor and a cantus sound an octave to each other, then the middle part...arranged above the tenor on a fifth...will be a fourth...below the highest pitch...Such a fourth...will concord extremely well...Secondly, when a tenor and cantus proceed by means of one or more sixths, then the middle voice...will always occupy the fourth below the cantus, always maintaining a third above the tenor...such a fourth...is accepted as harmonious in counterpoint...<sup>22</sup>

Gafurius was perhaps the first theorist of the period to attempt an explanation of this special condition regarding the fourth, when he said (in book 3, Chapter 6, entitled “Why the Fourth is Concordant Between a Middle and a Higher Sound and Discordant Between a Middle and a Lower Sound”):

The interval of a sixth mediated by a third above a tenor harmoniously supports a fourth between the middle and high terms because a fourth, arranged between those two concordant though imperfect intervals...is obscured by these intervals in the way that smaller things are obscured by larger ones. Even so, this fourth is recognized to have been evolved both from art and from nature. Higher sounds are generated by swifter vibrations. Thus they are weaker than lower sounds, which slower vibrations produce...Thus weakened by that velocity, the discordance of the fourth is concealed in the upper register. On the other hand, when a fourth is conceived in lower sounds, then its presence is pronounced, and it returns an unhappy sonority to the ear on account of the slowness of the vibrations...<sup>23</sup>

He does not say, however, why this same reasoning should apply only to the fourth, and not also to the other “concords.” Glarean, in the *Isagoge in musicen* (1516), also mentions these two conditions in which the fourth is considered consonant, as in the following:

In our times, the diatessaron likes to have the diapente beneath it, or else the ditone, for this it is frequently used by our polyphonic composers.<sup>24</sup>

but the fact that he was not altogether comfortable with the notion that these were the *only* conditions in which the fourth could be called a consonance is indicated by an earlier remark in the same passage:

The tone, in our times, in the nine to eight proportion, has been banished from the society of the consonances, for just what heinous crime I do not know. But I would not be concerned about the tone and its exile if this had not also happened with less excuse to the perfect fourth.<sup>25</sup>

Yet only a few years later, Pietro Aaron, in his *Toscanello in Music* (1523)—after listing the “consonances of counterpoint”—says about the fourth:

You should know that among the consonances above we have not mentioned the diatessaron or fourth, because this diatessaron by itself is dissonant. In a composition for two voices, this diatessaron without resolution is quite discordant, as experience shows.<sup>26</sup>

As Tinctoris had done three quarters of a century earlier, Zarlino, in *The Art of Counterpoint* (1558), again gives the classic definition of the fourth as a perfect consonance, though he admits that “practicing musicians have until now relegated it to the dissonances,”<sup>27</sup> and—as Matthew Shirlaw has noted:

No sooner has Zarlino affirmed this Fourth to be consonant, seeing that it is the inversion of the Fifth, than he treats it as a dissonance: it may be used between two upper parts...but is dissonant if heard between the *bass* and an upper part...<sup>28</sup>

The famous mathematician, Jerome Cardan (Hieronymus Cardanus), in *Writings on Music*, Part II (1574), assigns the fourth to a special category of “median” intervals, ranked after “pluperfect,” “perfect,” and “imperfect” intervals—but before the dissonances—in order of decreasing consonance.<sup>29</sup> He defines this category of “median” intervals as including “intervals dissonant in themselves but consonant in combination.”<sup>30</sup> Later, however, he classifies the fourth as “ambiguous” (along with the diesis and comma!), and gives the following as the second of four rules of counterpoint (the first of which forbids dissonances at the beginning or end of a piece, or on a long note, or on the first minim of a beat):

...when ambiguous intervals are used in the lower voices or in a two-voice composition, they dissonate in the same way as in the first rule by upsetting the composition’s relationship, for they become dissonant sounds.<sup>31</sup>

In neither of the above passages does Cardan make any more effort to give *reasons* for the dissonant treatment of the fourth than did most other theorists of this period—with the notable exception of Gafurius, whose proposed explanation was quoted earlier. In a much earlier treatise by Cardan, however (*De musica*, Part I, ca. 1546), there is an interesting passage that is relevant

to this question:

I do not consider a close relationship of intervals as necessarily a closer interval but rather a participation of the same nature. For instance, a quadruple proportion is closer to two than a triple proportion is to a duple proportion...For this reason a ditone is more consonant than a perfect fourth, for a ditone is exceedingly close to a *sesquiquarta* proportion, even though it is not formed as exactly, and a fourth is formed in an exact *sesquitertia* proportion.<sup>32</sup>

but if this argument were applied to all of the intervals listed by Cardan I suspect that the results would not be consistent with his own rank-ordering of these intervals.

With somewhat less equanimity than Cardan, Zarlino, or Gafurius (though evidently borrowing many of his principles from these last two), Thomas Morley—recalling that both Guido and Boethius had classified the fourth as a consonance, along with the fifth and octave—says:

...but why they should make diatessaron a consonant, seeing it mightily offendeth the ear, I see no reason...<sup>33</sup>

And yet—again, only a few years later—Johannes Lippius, in his *Synopsis of New Music* (1612), strenuously defends the consonant status of the perfect fourth—while just as strenuously attacking the Pythagorean (“diatonal”) tuning system (which might otherwise be suspected as having motivated his defense of the fourth)—in the following reverberant peroration:

Therefore they are in error, who today recognize no other diatonic scale aside from the old diatonal. They are deceived, who think that in this diatonal scale the major and minor thirds and sixths are consonances, or that they are consonances to the ear though not to the intellect. They labor under hallucination, who maintain that the simple consonance of the fourth is an outright imperfection. They suffer delirium, who out of ignorance of the causes of music feel that the fourth is a dissonance.<sup>34</sup>

Thus did the battle go on between the more speculative theorists like Lippius, Zarlino, and Glarean, who still considered the fourth to be a consonance, and those—generally the authors of more “practical” counterpoint treatises—for whom the fourth was unquestionably (though conditionally) a dissonance. It would seem that no other question in the entire previous history of music theory had ever generated such a fundamental and long-standing controversy. It is not within the scope of this book to propose theoretical solutions to problems such as this, but a brief consideration of certain *possible* solutions may help to clarify the historical mechanisms involved. First, it should have become evident by now that—whatever reasons the contrapuntal theorists (and composers) of this period may have had for treating the perfect fourth as a dissonance—these *must have been different* from those which consistently led

them to classify seconds, sevenths, the tritone, etc. as dissonances. Obviously, there was something disturbing to the musical continuity when a fourth occurred in two-part writing—or as the lowest interval in a three-part texture—but that disturbance could not have been caused by the same aspect of “sonorous quality” which had determined a dyad’s dissonant status in the 13th century—and which continued to be invoked over the next several hundred years. The conclusion seems inescapable to me that a *new criterion*—one representing *another aspect* of the “sonorous quality of simultaneous dyads”—had somehow become involved in the evaluation of consonance and dissonance. The theorists themselves do not tell us what this new criterion might have been—probably partly because it was neither a “rational” nor an easily “rationalizable” one, and partly because it was inextricably mixed up with the older criterion (or criteria) which had been the basis for consonance/dissonance classification in CDC-2. Nevertheless, two possible candidates suggest themselves immediately, the first involving a kind of incipient perception of harmonic roots. If we assume that the root phenomenon is applicable to dyads as well as triads and larger aggregates, and that (in accordance with theoretical concepts which only developed much later, of course) the fourth contains not only a strong root but also an inverted root (i.e. that its root is strongly “represented” by the upper note), then the fourth has a property which makes it unique among all the intervals. The only other commonly used interval which might be said to share this property of containing an inverted root is the minor sixth, but here the sense of “rootedness” is much weaker, so that the minor sixth would have been that much less “disturbing.” Still, it may be of some significance in this regard that the minor sixth was the last of the early-polyphonic “discords” to be admitted to what Glarean called “the society of the consonances.” Just why such a property of strong, inverted “rootedness” might have caused the fourth to be treated like a dissonance by the contrapuntal theorists is far from clear, but I think this factor deserves further consideration. If it was, in fact, the basis for a “new criterion” for consonance/dissonance evaluation, then the fairly sudden change in the status of the fourth in post-13th century theory might be taken as evidence that harmonic roots were already beginning to be perceived or “sensed” as early as the mid-14th century—and if this were true, then an important aspect of what we now call the triadic-tonal system (or “tonality”) would already have been affecting musical perception some three hundred years earlier than has generally been assumed.

Another explanation of the peculiar status of the perfect fourth in CDC-3 is possible, however, which does not invoke the concept (or perceptual phenomenon) of harmonic roots, and I am currently inclined to favor this second hypothesis (although it is quite possible that more than one factor was involved in this matter). If we consider what I will call the *harmonic-series aggregate* formed by each of the simultaneous dyads dealt with by contrapuntal theory we discover that—within the range outlined by the first three partials of the lower tone of each dyad—the harmonic-series aggregate for the fourth is the only one, among the consonances of CDC-2, in which some partial of the upper tone falls within a “critical band” of one or more of those first three partials of the lower tone (see Figure 5). In the harmonic-series aggregates for all of the other consonances this does not occur, and the octave

and fifth outlined by those partials of the lower tone are either “empty,” or—when “filled” by the interpolation of a component belonging to the upper tone—they are merely “mediated” at some interval equal to or greater than a critical band. In the harmonic-series aggregates for all of the *dissonances* of CDC-2, on the other hand, the situation is different. In every case, some partial of the upper tone *does* fall within a critical band of one of the lower tone’s first three partials. In the case of the sixths (which are still classified by John of Garland as dissonances), the second partial of the upper tone forms an interval of a second with the third partial of the lower tone, but here the added component is *above* that third partial, and the fifth (between the 2nd and the 3rd partials of the lower tone) remains “empty.” In this respect, then, the perfect fourth is not only unique among the consonances of CDC-2, but possesses a property which it shares with all of the dissonances of that same system.

What this acoustical analysis suggests is that there is a certain sense in which it can be said that the presence of a tone a fourth above another tone—as at any other “dissonant” interval above it—*interferes* with the most important spectral components of that lower tone in a way which might obscure not only its pitch-saliency but also its *textual intelligibility*. Given the usual tessitura of the lower voice in polyphonic music of the 14th through 16th centuries, these first three partials would lie within the same frequency-range as the first two vowel “formants,”<sup>36</sup> whose presence and accurate representation in the spectrum of any vowel sound are essential to the intelligibility of that vowel. As long as all of the voices were singing the same text simultaneously—as was presumably the case in the earliest forms of organum, and was still true of much of the later music of the *ars antiqua*—such “interference” would have created no problem. The appropriate formant regions would still have been emphasized in a way which would have preserved the intelligibility of the text. But with the increasing rhythmic and textual independence of the upper voices in polyphonic music of this later period, intelligibility would definitely have become a problem—particularly in relation to the *tenor*. Almost from the very beginnings of discant, the intervals formed by the added voices in polyphonic settings of traditional plain-chants were reckoned in relation to the tenor—and this was usually (though not invariably) the *lowest voice*. As Richard Crocker has noted:

...14th century discant describes primarily the construction of intervals *over* the tenor. It we were to survey 14th century music we should find that in motets *a 3* the tenor is usually the lowest part, hence the foundation in every conceivable sense.<sup>37</sup>

and Jeppesen, citing certain statements by Fux regarding dissonance-treatment in the style of Palestrina, has written:

...there is reason to presume that dissonances really, as Fux says, were as a rule especially noticed with respect to their relations towards the bass...<sup>38</sup>

We have already seen something of the severity of the suppressive reaction which the new contrapuntal procedures had elicited from a Pope in 1322,<sup>39</sup> and even as late as 1565 (the date of the first performance of Palestrina's *Missa Papae Marcelli*, "the requirements of the church... with regard to polyphonic liturgical music," as Jeppesen has said, "primarily concerned the intelligibility of the text."<sup>40</sup> But the innovations of the *ars nova*—already anticipated as early as the mid-13th century—were not to be given up without a struggle. Thus it could be that this otherwise "anomalous" treatment of the perfect fourth as a dissonance in CDC-3 arose in an effort to maintain the melodic and textual clarity of the lower voice—and thereby avoid clerical sanctions—without sacrificing the richness and complexity of a more elaborate kind of polyphony.

This hypothesis regarding the new criterion involved in consonance/dissonance classification in CDC-3 would suggest implicit definitions of 'consonance' and 'dissonance' somewhat different from those of CDC-2, because an additional factor would have to be included. A "consonance" (in the entitive sense) would now be a dyad which not only sounded, in some degree, "like a single tone," but in which the melodic and textual clarity of the lower tone was relatively unobscured. A "dissonance" would be one in which this melodic/textual clarity of the lower tone was obscured, as well as being one which could not be heard "as a single tone." A more precise definition of these terms—including a distinction between "perfect" and "imperfect" consonances—can easily be formulated on the basis of the harmonic-series aggregates described earlier, but I will leave this for another time and place.

Theoretical recognition of thirds and sixths as consonances—and the tolerance even for unbroken successions of several of these "imperfect" intervals in parallel motion—had occurred by the late 14th century with no more than cursory attempts to justify these changes theoretically, and thus primarily as a kind of pragmatic response to changes in musical practice. As was pointed out earlier, the ratios given for these intervals during the 14th and most of the 15th century were still those derived from Pythagorean tuning. The earliest theorist to suggest the replacement of these Pythagorean ratios by their simpler "just" forms was apparently Bartolome Ramos de Pareja, whose *Musica practica* (1482) gives instructions for obtaining these intervals on the monochord by means of

...a most easy division...by vulgar fractions...in order that the student may not need first to know both arithmetic and geometry.<sup>41</sup>

Of the earlier Boethian (or Pythagorean) division, he says that—although it is "useful and pleasant to theorists, to singers it is laborious and difficult to understand."<sup>42</sup> This new proposal created considerable tension *vis a vis* traditional theoretical doctrine, and Ramos was (to quote Strunk):

...violently attacked by Niccolo Burzio...just as his pupil Spataro was attacked later on by Franchino Gafori in his *Apologia* (1520). In the end, however...the new teaching won out despite all opposition.<sup>43</sup>

Gafori (Gafurius) had earlier described thirds and sixths as "irrational" intervals (though "suitable" in counterpoint) because they did not fit into the Pythagorean system. In the *Practica musicae* (1496) he had said:

Since the Pythagoreans...assigned every harmonic manipulation either to the multiple or to the superparticular, those intervals which are not part of the first three multiple proportions in the harmonic system and do not belong to the first two superparticulars are called irrational and indefinite. Incomposite thirds and incomposite sixths, however, from whose extremes concordances issue and which can be called irrational consonances notwithstanding, are suitable intervals for this discipline.<sup>44</sup>

Zarlino finally resolved the problem in a way that was true to the spirit, if not the letter, of the Pythagorean tradition, by an extension of the set of integers to be considered acceptable as ratio-terms for consonant intervals from 4 to 6—in his *senario*—thereby accommodating "just" thirds and sixths as not only consonant but "rational" as well. The enduring power of the Pythagorean world-view is exemplified again in the fact that Zarlino found it necessary to invoke cosmological reasons for this extension, although Zarlino's "cosmos" was naturally a very different one from that of the Pythagoreans. In his Introduction to the English translation of Part 3 of Zarlino's *The Art of Counterpoint*, Claude Palisca writes:

The common source of...music [for Zarlino] is number and proportion, and the all-important number is 6, the senary number, or *numero senario*. The number 6 has the virtue of being the first perfect number, meaning that it is the sum of all the numbers of which it is a multiple... Many evidences are given of the power of this number. There are 6 planets in the sky... There are 6 species of movement... according to Plato, there are 6 differences of position... There are 6 types of logic, and the world was created in 6 days. And these do not exhaust the list. In music, the significance of the *senario* is that all the primary consonances can be expressed as superparticular ratios using only numbers from 1 to 6.<sup>45</sup>

The similarities between this kind of argument and those used by the Pythagoreans some two millennia earlier are obvious, if we simply substitute *tetraktys* (or *quaternary*) for *senario*. Indeed, these two concepts were elegantly synthesized into a single explanatory system (with just a slight "stretching" of the new limits to include the number 8, and thereby the 8/5 ratio of the "just" minor sixth) by Johannes Lippius in his *Synopsis*... (1612), when he wrote:

The first three consonances, namely, the octave, fifth, and fourth, are otherwise commonly referred to as perfect consonances, because they are contained within that natural series

of simple and radical numbers, 1, 2, 3, and 4, known as the Pythagorean quaternary. The remaining four, namely, the ditone, semiditone, major sixth, are considered imperfect, because they lie outside the quaternary but within the senary (the first perfect and earthly number) and the octonary (the first cubic number).<sup>46,47</sup>

Although the new theoretical rationalization of thirds and sixths initiated by Ramos in 1482 had no effect on either the classification of intervals or the rules of their treatment in counterpoint (these remained essentially the same as they had been a hundred years earlier), it did coincide with a rather precipitous increase in the *use* of the third in the final chord of cadences. Wienpahl (1960) has shown that the third was present in 39% of all final tonic chords in the latter half of the 15th century, compared to only 3% in the first half, although "only in the last decade of the 15th century did such a feature become quite common."<sup>48</sup> In addition, Strunk (1974) has presented some statistical data which indicate that the use of the third with the fifth to form complete triads *throughout* the texture became more and more frequent during the period from 1450 to 1550.<sup>49</sup> This increasing incidence of complete triads in the music of the 15th and 16th centuries was one of several factors which led to a revolution in musical practice in the 17th century which was as radical as that which had/occurred in the 14th, and central to this development was the *concept* of the triad as a basic harmonic entity, rather than merely a fortuitous result of certain combinations of dyads. Zarlino seems to have been on the verge of this concept in 1558, when he wrote:

...observe that a composition may be called perfect when, in every change of chord, ascending or descending, there are heard all those consonances whose components give a variety of sound...these consonances that offer diversity to the ear are the fifth and third or their compounds... Since harmony is a union of diverse elements, we must strive with all our might, in order to achieve perfection in harmony, to have these two consonances or their compounds sound in our compositions as much as possible.<sup>50</sup>

but the concept of inversional equivalence which is such an essential aspect of the modern conception of the triad is nowhere to be found in Zarlino. Nor is it yet clearly formulated in the *Isagoge* (1581) by Johannes Avianius, although (according to Benito Rivera) this theorist seemed to be "at the brink of recognizing such a concept" in that work.<sup>51</sup> Similarly, although the increasingly normative character of the root-position triad is reflected in early 17th-century figured bass notation by the mere fact that it was the only chord which required no "figures," the concept of the harmonic identity of root-position and inverted forms of the triad was never explicit in that notation, and was only introduced as an additional—and somewhat incidental—observation in figured bass treatises of the 18th century, sometime *after* the publication of Rameau's *Treatise on Harmony* in 1722. Francesco Gasparini's *The Practical Harmonist at the Harpsichord* of 1708 contains no reference to the concept of inversion,<sup>52</sup>

whereas Heinichen's *Der General-Bass...* of 1728 includes the following:

That in the chord of the sixth the doubling of the third and sixth would be much more natural than the doubling of the bass, can be shown most easily in its origin, namely the inversion of the triad...<sup>53</sup>

It was in the writings of certain earlier German theorists, contemporaneous with—but apparently not yet affected by—the earliest developments of figured bass notation, that the triadic concept first appears in substantially the form in which we understand it today—most notably (as Joel Lester has shown<sup>54</sup>) in treatises by Otto Siegfried Harnisch (1608) and Johannes Lippius (1610 and 1612). In the latter's *Synopsis of New Music*, which has been quoted here before, the term *trias harmonica* is used for the first time, and eulogized as follows:

The harmonic, simple, and direct triad is the true and unitrisonic root of all the most perfect and most complete harmonies that can exist in the world. It is the root of even thousands and millions of sounds... Recently some have had intimations of it in a somewhat confused manner although (very strangely) it is much employed in practice and...stands as the greatest, sweetest, and clearest compendium of musical composition.<sup>55</sup>

Both Harnisch and Lippius make a clear distinction between the "basis" of the triad (our "root") and the lowest note in a chord, thus recognizing the harmonic equivalence of root-position and inverted forms of the triad—although clearly preferring the former as more "perfect." Yet—in spite of the clarity with which the triadic concept is articulated by these theorists—there is little to indicate that they conceived consonance and dissonance in any new way. If anything, Lippius's definitions of these terms are more suggestive of CDC-2 than they are of CDC-3, and his listing of consonant dyads—"according to [their] order of perfection;"<sup>56</sup> as octave, fifth, fourth (N.B.), ditone, semiditone, major sixth, and minor sixth—is simply a modified (or modernized) version of CDC-2, implying a graded continuum of *qualities* rather than the set of operational *characteristic* of CDC-3. In addition, the *consonance or dissonance of any triad (I.E. any 3-note aggregate, not just the trias harmonica)* is explained as the result of the consonance or dissonance of its constituent dyads—thus:

The musical triad consists of three radical sounds and of as many radical dyads. It is consonant or harmonic when its elements [i.e. its constituent dyads] are consonant, dissonant or unharmonic when they are dissonant... [and]... Concerning the unharmonic dissonant triad...it results radically from seconds... According to the nature of the combined awkward proportions, the dissonance will be less if the triad consists not merely of seconds. If it consists merely of seconds, the dissonance will be greater.<sup>58</sup>

One can easily imagine that Zarlino would have had no difficulty in accepting these new insights as logical generalizations and extensions of certain aspects of 16th-century practice, quite compatible with his own theoretical formulations. But the profound changes in musical style that had been initiated three decades earlier by members of the Florentine "Camerata" were not so compatible with 16th-century traditions, as may be seen in the bitter debates which raged from the 1580's (between Zarlino and Vincenzo Galilei) through the first decade of the 17th century (Artusi vs. the brothers Monteverdi). Among other things which were at issue in these debates was the propriety of certain new *uses* of dissonance in what Claudio Monteverdi came to call the *seconda pratica*, but it is important to note that this "second practice" did not involve a new *conception* of consonance and dissonance, but rather new *attitudes* regarding their use. Thus—in his Forward to the Fifth Book of Madrigals (1605), Claudio Monteverdi had written:

Some, not suspecting that there is any practice other than that taught by Zarlino, will wonder at this, but let them be assured that, with regard to the consonances and dissonances, there is still another way of considering them, different from the established way...<sup>59</sup>

and his brother, in 1607, adds the following comments:

...with regard to the consonances and dissonances, *that is, with regard to the manner of employing the consonances and dissonances...[and]...* By the established way of considering the consonances and dissonances, *which turns on the manner of their employment*, my brother understands those rules of the Reverend Zarlino that are to be found in the third book of his *Institutions* and that tend to show the practical perfection of the harmony, not of the melody...[Zarlino's] precepts and laws...are seen to have no regard for the words, for they show the harmony to be the mistress and not the servant. For this reason my brother will prove to the opponent [Artusi] and his followers that, when the harmony is the servant of the words, *the manner of employing the consonances and dissonances is not determined in the established way*, for the one harmony differs from the other in this respect [my emphases].<sup>60</sup>

As Claude Palisca has pointed out, Vincenzo Galilei "had already set down and defended the principals and practices of the *seconda pratica*" in an important counterpoint treatise of 1588.<sup>61</sup> In this work, Palisca says further, Galilei proposed a new, "empirical" classification of intervals which:

...could work as a wedge the harmonic resources of his time... The consonances were the octave, thirds, fifth, and sixths, including the much maligned minor sixth; the dissonances were the seconds and sevenths. The fourth, augmented fourth, and diminished fifth he placed in an in-

termediate category, because they sounded less harsh to the ear and were subject to fewer restrictions than the other dissonant intervals.<sup>62</sup>

This classification system—like that of Lippius—seems to have reintroduced certain aspects of CDC-2, but this earlier form of the CDC had never really disappeared. It had merely undergone a certain operational reduction, and a (temporary) modification due to the inclusion of a new criterion for consonance and dissonance evaluation. And Galilei is by no means the first or only theorist to revive the "graded continuum" which was characteristic of CDC-2. When Zarlino, for example, said:

The fifth is less perfect than the octave, and the fourth less perfect than the fifth...[and later]...the fourth is more perfect than the ditone, and it more perfect than the semitone...<sup>63</sup>

he was giving a rank order to these intervals entirely consistent with those of CDC-2. But whichever form of the CDC was involved, the protagonists on both sides in these debates—while disagreeing about the "manner of employing the consonances and dissonances"—nevertheless shared a set of common assumptions as to the *meanings* of these terms.

Changes of a more subtle kind were also occurring in the early 17th century, however, which were destined to prepare the ground for a radically new form of the CDC in the 18th century. These changes involved the entitive use of the words 'consonance' and 'dissonance', and were manifested in two different ways. The first (and perhaps least important) of these changes was a gradual extension of the range of entitive reference of 'consonance' and 'dissonance' to include triads and larger aggregates, as well as dyads. Whereas earlier theorists undoubtedly considered the various chords listed in their "Tables" to be consonant, they did not actually call them "consonances" (nor did they use the term "consonance table" as does Helen Bush in her article on this subject;<sup>64</sup> Pietro Aaron calls his list a "Table of Counterpoint,"<sup>65</sup> Zarlino merely a "Table,"<sup>66</sup> and Morley "A Table Containing the Chords which are to be used in the composition of songs for three voices,"<sup>67</sup> and "A table containing the usual chords for the composition of four or more parts"<sup>68</sup>). In fact, none of these theorists ever seems to refer to these larger aggregates as "consonant," although I think it is safe to say that they would not have considered this adjective inappropriate. Lippius, of course, explicitly refers to "consonant" and "dissonant" triads in the *Synopsis*..., but he does not call them "consonances" or "dissonances"—although Avianius had done so earlier. Harnisch (in 1608) and Johann Magirus (in 1611) use the word 'consonance' in this sense, for the (harmonic) triad—but with a verbal qualification; it was a "compound (or composite) consonance."<sup>69</sup> Eventually such qualifying terms would be dropped, but even then this form of entitive reference is not to be found as often as one might imagine.

The second kind of transformation with respect to the entitive reference of 'consonance' and 'dissonance' which begins to occur in the 17th century is more important—at least in the light of later developments in the CDC. These

terms began to be used for *individual notes* in an aggregate—as well as for its constituent dyads, or for the aggregate as a whole. In the beginning, this transformation apparently arose out of an inherent ambiguity in figured bass notation—and in the descriptive language of figured bass theorists. The numerical “figures” associated with a given bass note, originally denoting intervals to be formed above that bass note, could also be interpreted as “pointers” to (and thereby symbols for) *the upper notes themselves*—those which the performer had to locate in order to produce the required intervals. Thus, for example, the figure 4, in conjunction with a bass note C, comes to mean not only the interval C-F, but the *note F* as well—and since the interval of a fourth (above the bass) is a dissonance (in CDC-3), the note F by itself can be called “a dissonance” in this context. This ambiguity is so subtle that it is often extremely difficult or impossible to determine whether one or the other of these two meanings (or both) was actually intended by a writer, but in certain passages the meaning is made clear by the context. The possibility that a numerical figure could already be interpreted as the upper note as distinct from the interval which that note formed with the bass is suggested as early as 1602 in Caccini’s *Le Nuove Musiche*, where he says:

Inasmuch as I have been accustomed, in all my musical works which have appeared, to indicate by figures over the Bass part the major Thirds and Sixths where a sharp is marked, and the minor ones where there is a flat, and, in the same way, [to indicate] that Sevenths and other discords should be included in the accompaniment [in the intermediate parts], it now remains to be said that the ties in the Bass part have been used by me, because, after the consonance *only the note figured [la corda segnata] is to be struck again...* [my emphasis].<sup>70</sup>

On the other hand, a distinction between these two meanings for the figures seems implied in Agazzari’s instructions regarding the interpretation of accidentals (in *Del sonare sopra il basso...*, 1607):

...an accidental below or near a note [in the bass part] refers to the note itself, while one above it refers to the consonance which it serves to indicate...<sup>71</sup>

although here, too, there is considerable ambiguity. Other examples which imply that the figures (and thus the “consonances” and “dissonances” they denoted) may have referred to individual upper notes are not hard to find. Thus, in a treatise of 1626 by Johann Staden, we read:

As concerns the *numeri* or figures, they have hitherto been put in, for the most part, on account of dissonances, such as Seconds, Fourths, Sevenths, and Ninths, etc., and also the Thirds and Sixths, as imperfect consonances, to show that the *Organist is not to touch any dissonances where they are not indicated*, but is to keep to his consonances and discords... [and later]... *The Second, before being touched*, must

be preceded by a consonance, such as the Third, Fifth, or Sixth, and resolves on the Third or Sixth, sometimes also on the Fifth... Therefore *the striking of the consonances before the dissonances* is of no little importance, and it is not enough just to use the dissonances without discretion, for the dissonances are generally introduced in syncopation, as it is seen here in the case of the Fourth, which is used in many different ways and resolves on a Third [my emphases].<sup>72</sup>

and similar references to “touching” or “striking” a consonance or dissonance are also to be found in a treatise of 1628 by Galeazzo Sabbatini.<sup>73</sup>

The extent to which theorist’s language of description had changed in a mere 50 to 75 years is indicated by a comparison of the preceding with the following passage from Zarlino (1558), also dealing with syncopation:

...in the principal cadences the parts should be so arranged that the dissonant second part of a syncopated note is always a fourth or eleventh above the bass and a second or seventh from the other voice. This applies to all syncopations involving a dissonance...<sup>74</sup>

or with the following distinctions regarding the diminished fifth—with and without syncopation—by Vincenzo Galilei:

When the dissonance is caused by the lower voice [i.e. when the lower voice is syncopated], it will be less hard than when it is caused by the upper voice, and it will be hardest whenever it is caused by the concurrent movement of both voices [i.e. when they both begin simultaneously].<sup>75</sup>

Here, whereas the syncopated note may “cause” the dissonance, it is not called “a dissonance” (which is what it will be called in later figured bass treatises). And what Zarlino means by “note” in the preceding quotation is essentially the *time-value* represented by the notational symbol, and its “dissonant second part” is that temporal portion of the syncopated note during which a dissonant dyad is formed with another voice.

Among a set of nine “rules for the treatment of a Thorough-Bass,” published (according to Arnold) in 1640 by Heinrich Albert (nephew and pupil of Heinrich Schütz), the first three read as follows:

- (1) Assume that all Musical Harmony, even though it were conveyed in a hundred parts at once, consists only of *Three Sounds*, and that the Fourth, and all other parts, must of necessity coincide, in the Octave, with one of these three.
- (2) Thus the Thorough-Bass (‘General-Bass’) is the lowest sound of every piece of Music, *to which one must adapt and play its consonances* in accordance with the indication of the composer.
- (3) Everywhere, therefore, where no figures or *signa* appear

58. *The contrapuntal and figured-bass periods (CDC-3)*

above it, the Fifth and Third are to be taken and played in accordance with the key in which a piece is written. In so doing, take heed always to keep such consonances close together, and to cultivate the practice of varying them nicely, in suchwise that, when the Bass is high, the Third is, for the most part, nearest to it, and when it is low, the Fifth. By which observance you can also guard against many Fifths and Octaves being heard in succession and perchance causing displeasure [my emphases].<sup>76</sup>

While it may well be that the "Fifths and Octaves" referred to in the last sentence are the *dyads* so designated, the fifths and thirds mentioned in the first two sentences of the 3rd rule are the individual *notes* "taken and played," and the "consonances" of the second sentence are most certainly notes, not intervals.

By the beginning of the 18th century, this transformation in the entitive reference of 'consonance' and 'dissonance' was no longer a matter of ambiguity; it had become a well-established verbal convention—as may be seen in the following passage from Gasparini's *The Practical Harmonist at the Harpsichord* (1708):

The second may be considered the same as the ninth, since the ninth is the compound of the second, and because ordinarily one indicates a second and the interval will be a ninth. There is, however, a notable difference between the two, since the second does not derive from, but proceeds to a tie, that is to say, when the bass is tied or syncopated. In this case the second does not resolve, as do the other dissonances, but instead the bass itself resolves downward [my emphasis].<sup>77</sup>

It is important to note, however, that this use of the word 'dissonance' had by no means replaced an earlier usage—it had simply been *added* to the unwritten lexicon of musical terminology, *along with* those earlier usages. Nor were the results of this new use of 'dissonance' in any way contradictory to those of its earlier entitive sense (in CDC-3). The note indicated by a figure was a consonance or a dissonance according to whether it formed a consonant or dissonant dyad in combination with the written bass note. And it was always the *upper* note of the dyad, regardless of whether it was that note or the bass which was obliged to resolve—as in Gasparini's distinction between second and ninth. The conception of consonance and dissonance implicit in figured bass practices thus remained merely an extension of CDC-3. And yet, the century-old habit of ascribing consonance or dissonance to an individual tone in a chord—even if it had been nothing more than a convenient shorthand—had become so commonplace by the early 18th century that even Jean-Philippe Rameau—in 1722—hardly seems to notice that he is articulating a radically new conception of consonance and dissonance, although he is quite clearly aware of the innovative nature of most of his other theoretical ideas. Central to this new conception—which will be called CDC-4—was a new definition of "consonant (or dissonant) note," and its implications and later manifestations will be considered in the next section of this book.

NOTES Part Two: Section III.

1. Oliver Strunk, *Source Readings in Music History* (New York: Norton, 1950), pp. 154-56.
2. Richard Crocker, "Discant, Counterpoint, and Harmony," *Journal of the American Musicological Society* Vol. 15 (1962), p. 6.
3. Thomas Morley, *A Plain and Easy Introduction to Practical Music* (1597), edited by Alec Harman (New York: Norton, 1952), pp. 205-6.
4. Ruth Halle Rowen, *Music Through Sources and Documents* (Englewood Cliffs, New Jersey: Prentice-Hall, 1979), p. 90.
5. Johannes Tinctoris, *Dictionary of Musical Terms (Terminorum Musicae Diffinitorium, 1475)*, translated by Carl Parrish (London: The Free Press of Glencoe, Collier-Macmillan, 1963), pp. 15 and 25.
6. Johannes Tinctoris, *The Art of Counterpoint (Liber de Arte Contrapuncti, 1477)*, by Albert Seay (Stuttgart: American Institute of Musicology, 1961), p. 17.
7. *Ibid.*, p. 85.
8. *Ibid.*, p. 17.
9. Gioseffo Zarlino, *The Art of Counterpoint (Part Three of Le Istitutioni harmoniche, 1558)*, translated by Guy A. Marco and Claude V. Palisca (New Haven and London: Yale University Press, 1968), p. 19.
10. *Ibid.*, p. 34.
11. *Ibid.*, p. 53.
12. Morley, *op. cit.*, p. 141.
13. Jean-Philippe Rameau, *Treatise on Harmony* (1722), translated by Philip Gossett (New York: Dover, 1971), p. xli.
14. *Ibid.*, p. xlii.
15. James W. Krehbiel, *Harmonic Principles of Jean-Philippe Rameau and his Contemporaries* (Ph.D. Diss., Indiana University, 1964), p. 25.
16. E. g., Allen Forte, in *Tonal Harmony in Concept and Practice* (New York: Holt, Rinehart and Winston, 1962), says (pp. 16-17): "In music the terms consonant and dissonant have nothing whatsoever to do with the pleasant or unpleasant quality of a sound. They are technical terms applied to phenomena of motion." One must ask: in what music?—and in whose view? This was certainly not the view of the major theorists who first formulated the concepts and practices of tonal harmony.
17. Crocker, *op. cit.*, p. 6.
18. Gustave Reese, *Music in the Middle Ages* (New York: Norton, 1940), p. 294.
19. E. de Coussemaker, *Scriptorum de Musica Medii Aevi Nova Series* (hereafter abbreviated *CouS*), 4 vols. (Paris, 1864; reprint, Hildesheim: Georg Olms, 1963), Vol. III, p. 195: "...quod quarta et sibi equivalentes minus dissonant quam alie combinationes /sic/ dissonantes, imo quodammodo medium tenant inter consonantias veras et dissonantias, in tantum quod, secundum quod quidam dicunt, ab antiquis inter consonantias numerabantur."
20. Tinctoris, *The Art of Counterpoint, ibid.*, p. 20.
21. *Ibid.*, p. 29.
22. Irwin Young, translator, *The Practica Musicae of Franchinus Gafurius* (Madison, Milwaukee and London: The University of Wisconsin Press, 1969), pp. 139-40.
23. *Ibid.*, p. 141.
24. Frances Berry Turrell, "The *Isagoge in Musicen* of Henry Glarean," *Journal of Music Theory*, Vol. 3 (1959), pp. 97-139 (see esp. p. 125).

25. *Ibid.*
26. Pietro Aaron, *Toscanello in Music* (1523), translated by Peter Bergquist (Colorado Springs: Colorado College Music Press, 1970), Book II, p. 23.
27. Zarlino, *op. cit.*, p. 12.
28. Matthew Shirlaw, *The Theory of Harmony* (London: Novello, 1917; reprint, New York: Da Capo, 1969), p. 43.
29. Hieronymus Cardanus, *Writings on Music*, translated by Clement Miller (Stuttgart: American Institute of Musicology, 1973), p. 83.
30. *Ibid.*
31. *Ibid.*, pp. 144-45.
32. *Ibid.*, pp. 40-41.
33. Morley, *op. cit.*, p. 205.
34. Johannes Lippius, *Synopsis of New Music (Synopsis Musicae Novae, 1612)*, translated by Benito V. Rivera (Colorado Springs: Colorado College Music Press, 1977), p. 37.
35. The *critical band* is an interval within which frequency components are not well "resolved" or separated on the basilar membrane of the inner ear, and thus interact significantly, giving rise to various forms of "non-linear" distortion (beats, combination tones, mutual "suppression," masking effects, etc.). Within the frequency range of most importance to musical (and linguistic) perception, the size of this interval is approximately a minor third, and the argument here assumes that any two frequency components less than a minor third apart are "within" a critical band. I should note that I am not as much concerned here with the *beats* which result from this interaction as I am with *masking* and other, more general aspects of this non-linearity. For more information, see Reinier Plomp, *Aspects of Tone Selection* (London, New York, San Francisco: Academic Press, 1976).
36. A *formant* (or *formant region*) is one of several peaks in the spectral envelope of a vowel sound, whose center frequencies are controlled by the resonant cavities of the upper vocal tract.
37. Crocker, *op. cit.*, p. 145.
38. Knud Jeppesen, *The Style of Palestrina and the Dissonance* (London: Oxford University Press, 1946; reprint, New York: Dover, 1970), p. 166.
39. *Vide supra*, Section II, pp. 38-9.
40. Jeppesen, *op. cit.*, p. 41.
41. Strunk, *op. cit.*, pp. 201-2.
42. *Ibid.*
43. *Ibid.*, p. 200.
44. Young, *op. cit.*, pp. 123-4.
45. Zarlino, *op. cit.*, p. xv.
46. Lippius, *op. cit.*, p. 36.
47. Claude Palisca, in "Vincenzo Galilei's Counterpoint Treatise: A Code for the *Seconda Pratica*," *Journal of the American Musicological Society*, Vol. 9 (1956), pp. 81-96, points out that this extension of the limit from 6 to 8 had already been made by Zarlino in his *Dimonstrationi harmoniche* of 1571 (and thus 41 years before Lippius's *Synopsis*...), but it is with the *senario* that Zarlino's name is most commonly associated (see Palisca's footnote #17, p. 85).
48. Robert W. Wienpahl, "The Evolutionary Significance of 15th Century Cadential Formulae," *Journal of Music Theory*, Vol. 4 (1960), pp. 131-152.
49. Oliver Strunk, *Essays on Music in the Western World* (New York: Norton, 1974), pp. 70-78.
50. Zarlino, *op. cit.*, pp. 186-88.
51. Benito V. Rivera, "The *Isogoge* of Johannes Avianus: An Early Formulation of Triadic Theory," *Journal of Music Theory*, Vol. 22 (1978), pp. 43-64.
52. Francesco Gasparini, *The Practical Harmonist at the Harpsichord*, translated by Frank S. Stillings, edited by David L. Burrows (New Haven and London: Yale Univer-

sity Press, 1968).

53. George J. Buelow, *Thorough-Bass Accompaniment to Johann David Heinichen* (Berkeley and Los Angeles: University of California Press, 1966), p. 24.
  54. Joel Lester, "Root-Position and Inverted Triads in Theory around 1600," *Journal of the American Musicological Society*, Vol. 27 (1974), pp. 110-19.
  55. Lippius, *op. cit.*, p. 41.
  56. *Ibid.*, pp. 34-36.
  57. *Ibid.*
  58. *Ibid.*, p. 43.
  59. Strunk, *Source Readings...*, *ibid.*, pp. 409-10.
  60. *Ibid.*
  61. Palisca, "Vincenzo Galilei's Counterpoint Treatise...", *ibid.*, p. 81.
  62. *Ibid.*, p. 86.
  63. Zarlino, *op. cit.*, pp. 17 and 18.
  64. Helen Bush, "The Recognition of Chordal Formation by Early Music Theorists," *Musical Quarterly*, Vol. 32 (1946), pp. 227-43.
  65. Pietro Aaron, *op. cit.*, p. 40.
  66. Zarlino, *op. cit.*, pp. 182-3.
  67. Morley, *op. cit.*, p. 222.
  68. *Ibid.*, pp. 226-7.
  69. Benito Rivera, *op. cit.*, and Joel Lester, *op. cit.*
  70. F.T. Arnold, *The Art of Accompaniment from a Thorough-Bass* (London: Oxford University Press, 1931; reprint, New York: Dover, 1965, in two volumes), pp. 42-43 (Vol. I).
  71. Strunk, *Source Readings...*, *ibid.*, p. 426, and in Arnold, *op. cit.*, p. 69.
  72. Arnold, *op. cit.*, pp. 106-7.
  73. *Ibid.*, pp. 110-26, but see especially pp. 112-13.
  74. Zarlino, *op. cit.*, p. 200.
  75. Palisca, *op. cit.*, p. 92.
  76. Arnold, *op. cit.*, pp. 127-8.
  77. Gasparini, *op. cit.*, p. 49.
- sity Press, 1968).
53. George J. Buelow, *Thorough-Bass Accompaniment to Johann David Heinichen* (Berkeley and Los Angeles: University of California Press, 1966), p. 24.
  54. Joel Lester, "Root-Position and Inverted Triads in Theory around 1600," *Journal of the American Musicological Society*, Vol. 27 (1974), pp. 110-19.
  55. Lippius, *op. cit.*, p. 41.
  56. *Ibid.*, pp. 34-36.
  57. *Ibid.*
  58. *Ibid.*, p. 43.
  59. Strunk, *Source Readings...*, *ibid.*, pp. 409-10.
  60. *Ibid.*
  61. Palisca, "Vincenzo Galilei's Counterpoint Treatise...", *ibid.*, p. 81.
  62. *Ibid.*, p. 86.
  63. Zarlino, *op. cit.*, pp. 17 and 18.
  64. Helen E. Bush, "The Recognition of Chordal Formation by Early Music Theorists," *Musical Quarterly*, Vol. 32 (1946), pp. 227-43.
  65. Pietro Aaron, *op. cit.*, p. 40.
  66. Zarlino, *op. cit.*, pp. 182-3.
  67. Morley, *op. cit.*, p. 222.
  68. *Ibid.*, pp. 226-7.
  69. Benito Rivera, *op. cit.*, and Joel Lester, *op. cit.*
  70. F.T. Arnold, *The Art of Accompaniment from a Thorough-Bass* (London: Oxford University Press, 1931; reprint, New York: Dover, 1965, in two volumes), pp. 42-43 (Vol. I).

71. Strunk, *Source Readings...*, *ibid.*, p. 426, and in Arnold, *op. cit.*, p. 69.
72. Arnold, *op. cit.*, pp. 106-7.
73. *Ibid.*, pp. 110-26, but see especially pp. 112-13.
74. Zarlino, *op. cit.*, p. 200.
75. Palisca, *op. cit.*, p. 92.
76. Arnold, *op. cit.*, pp. 127-8.
77. Gasparini, *op. cit.*, p. 49.

## Part Three

### From Rameau to the Present

## Section IV

### Rameau and his successors (CDC-4)

Each of the three conceptions of consonance and dissonance which have been distinguished so far in this book was the prevailing form of the CDC in theoretical writings during some particular historical epoch: CDC-1 from perhaps the 6th century B.C. to the 8th century A.D., CDC-2 from the 9th through the 13th centuries, and CDC-3 from the 14th through the 17th centuries. Thus, in the 9th century—and again in the 14th—a new interpretation of 'consonance' and 'dissonance' began to supercede an older one. But the aspect of musical perception denoted by these terms in their earlier interpretation did not—in either instance—simply disappear, or become any less real than it had been before. Although the changes in their descriptive language during these transitions may have involved the replacement of one set of meanings by another, the perceptual and conceptual changes which this language had to accommodate involved a cumulative process of *addition* of a new perceptual/conceptual acquisition to the earlier ones. CDC-1 and CDC-2 each survived the transition to a new form of the CDC, but in quite different ways. The semantic transformation associated with the transition from CDC-1 to CDC-2 in the 9th century had involved a radical shift of *referent* from (relations between) *successive tones* to (qualities of) *simultaneous dyads*. Following this transformation, CDC-1 appears in a new guise—e.g. as "affinities", "similarities", or "resemblances between notes" in Guido d'Arezzo.<sup>1</sup> By comparison, the transition from CDC-2 to CDC-3 in the 14th century did *not* involve such a shift of referent, with the result that some ambiguity and confusion of the two senses was almost inevitable. The ambivalent status of the fourth during this period is just one obvious symptom of this confusion, but another is recurrent references to consonance and dissonance which do not bear that direct, operational correspondence to the rules of counterpoint which is so characteristic of CDC-3. Examples of such references have already been quoted from Lippius, Vincenzo Galilei, and Zarlino.<sup>2</sup> And although a radically new conception of consonance and dissonance is clearly discernible in the writings of Rameau, all of the earlier forms of the CDC are to be found there as well. Thus, for example, CDC-1 and CDC-2 are both implied in the following definitions from the "Table of Terms" in the *Treatise on Harmony* (1722):

CONSONANCE... This is an interval the union of whose sounds is very pleasing to the ear. The intervals of the third, the fourth [N.B.], the fifth, and the sixth are the only consonances [CDC-2]. When we say *consonant progression*, we mean that the melody should proceed by one of these intervals [CDC-1].<sup>3</sup>

DISSONANCE... This is the name for intervals which, so to speak, offend the ear [CDC-2]. We say *dissonant progression* when we wish to indicate that the melody should pro-

ceed by one of these intervals [CDC-1].<sup>4</sup>

CDC-2 is also implied in the following passage, where he gives the same rank order for the consonances as those given earlier by Lippius and Zarlino—and the same numerical rationale for it:

The order of origin and perfection of these consonances is determined by the order of the numbers. Thus, the octave between 1 and 2, which is generated first [by integral divisions of a string], is more perfect than the fifth between 2 and 3. Less perfect again is the fourth between 3 and 4, etc., always following the natural progression of the numbers and admitting the sixths only last.<sup>5</sup>

References to CDC-3 are less frequent in the *Treatise*..., and when they do occur they seem to reflect little more than the fact that its three interval-categories had become by then a convenient alternative to listing the intervals individually. Thus, in describing the similarities between an interval and its octave-complement, he says:

If one sound forms a perfect consonance with the fundamental sound, it will also form a perfect consonance with its octave; if another forms an imperfect consonance or a dissonance on the one hand, it will also form an imperfect consonance or a dissonance on the other...<sup>6</sup>

and when he deals with the conventional rules of two-part counterpoint (in Chapter 36 of Book III, "On Composition in Two Parts"), he says:

Consonances must be distinguished as perfect or imperfect. The perfect consonances are the octave and the fifth... The fourth is also a perfect consonance, but since it is hardly appropriate in a composition in two parts, we shall be content simply to prescribe the way in which it should be used... The imperfect consonances are the third and the sixth. Several of these may be used in succession...<sup>7</sup>

yet even here CDC-2 seems to be lurking in the background, resisting complete replacement by CDC-3. Such definitions and uses of 'consonance' and 'dissonance' recur persistently in the writings of most theorists after Rameau too, but they are merely borrowed from earlier theoretical traditions.

What is new in the *Treatise*...—and often at odds with his own more conventional statements—is announced in passages like the following:

Since the source is found only in the first and fundamental sound and then in the chord it should bear, we cannot determine the properties of an interval unless we have previously determined those of the fundamental sound and of the complete chord which accompanies it... If we examine an interval in isolation, we shall never be able to define its properties; we must also examine all the different chords in which it may occur [my emphasis].<sup>8</sup>

Rameau was unable to maintain this position consistently, as there are frequent references in the *Treatise*... and other works to the properties of isolated intervals, but the idea that such properties of an interval—including its consonance or dissonance—can only be derived from a consideration of "all the different chords in which it may occur" amounts to a complete reversal of all previous assumptions about the relationship between intervals and chords. To the extent that aggregates other than dyads had been dealt with at all by earlier theorists, the properties of chords depended entirely on those of their constituent intervals. But merely noting the fact of this reversal is still not sufficient to characterize the innovative nature of Rameau's position here, because—in his view—these chords only derive *their* properties from the *son-fondamental*—the "fundamental sound" or "source." Thus although he says that:

...harmony is contained in the two chords proposed: the perfect chord and the seventh chord. All our rules are founded on the natural progression of these two chords.<sup>9</sup>

nevertheless:

The source of harmony does not subsist merely in the perfect chord or in the seventh chord formed from it. More precisely, it subsists in the lowest sound of these two chords, which is, so to speak, the harmonic center to which all the other sounds should be related...all the properties of these chords depend completely on this harmonic center and on its progressions.<sup>10</sup>

In the *Treatise*...—written before his discovery of the work of Sauveur demonstrating the presence of harmonic partials in every musical tone—this source is found in the "undivided string," which:

...contains in its first divisions those consonances which together form a perfect harmony.<sup>11</sup>

and about which he had said, in an earlier passage:

...all properties of...sounds in general, of intervals, and of chords rest finally on the single, fundamental source, which is represented by the undivided string...<sup>12</sup>

In the *Nouveau Système de Musique Théorique* (1726)<sup>13</sup> and all of his subsequent writings this source is identified with the single (compound) tone itself—the *corps sonore* or "sonorous body." In one of his later theoretical works (*Démonstration du Principe de l'Harmonie*, 1750), he says:

The sounding body, which I justly call *fundamental sound*—this unique principle, generator and arranger of all music, this immediate cause of all its effects—the sounding body, I say, no sooner resonates than it engenders simultaneously all the continuous proportions from which are born harmony, melody, the modes, the genres, and down to the least rules

necessary to practice.<sup>14</sup>

Rameau, of course, did not invent or discover the concept of the *son-fundamental*. As was noted in Section III, it had been described by several theorists over a hundred years earlier—and the term appears in the definition of *trias harmonica* in Brossard's *Dictionnaire de Musique* of 1705<sup>15</sup> (a work cited by Rameau in the *Treatise*...). But then, Rameau did not *claim* to have invented or discovered the concept. In fact, he believed that it was already known and described by Zarlino—but then, inexplicably, forgotten or “abandoned” by him. Thus, Rameau writes:

After having stated that music is subordinate to arithmetic, that the unit, which is the source of numbers, represents the sonorous body from which the proof of the relationship between sounds is derived, and that the unison is the source of consonances, Zarlino forgets all this in his demonstrations and rules. Far from following the principle he has just announced, the further he goes the more he draws away from it. Though he cannot avoid letting us see that the source is found in the undivided string, which is the sonorous body just mentioned and whose division he proposed, he nevertheless makes us forget this by introducing a new operation... All the difficulties that Zarlino creates in his harmonic operations would not have existed, had he remembered the source which he had first proposed. Far from pointing it out everywhere, however, he immediately abandons it.<sup>16</sup>

What first of all distinguishes Rameau from his predecessors is his effort to create a *complete theoretical system* on the basis of little more than this single concept. In this effort—as he tells us in the *Démonstration*...—he was inspired by the example of René Descartes, whose *Méthode*<sup>17</sup> he had read, and which, he says, “had amazed me.”<sup>18</sup> In that same work of Rameau's, he recalls his earliest motivations:

Has anyone sought in nature some fixed and invariable point from where we may proceed with certainty and which would serve as the basis for melody and harmony? By no means! Rather there have been some experiments, some fumbling about, some compiling of facts, some multiplying of signs... Such was the state of things when, astonished at the troubles I myself had experienced in learning what I knew, I dreamed of a means of abrogating this difficulty for others... Enlightened by the *Méthode* of Descartes... I began by examining myself... I tried singing somewhat as a child would do... I examined what took place in my brain and voice... There were... certain sounds for which my voice and ear seemed to have a predilection: and that was my first perception. But this predilection appeared to me purely a matter of habit... I concluded that since I did not find in myself any good reason for justifying this predilection and for regarding it as natural, I ought /not/ to take it as the principle of my research.../and/...that I would not encounter it within

myself and I abandoned the pleasant...for fear that they would engulf me in some system which would perhaps be my own, but which would not at all be that of nature... I began to look around myself and to search in nature for what I could not draw out of my own background, neither as absolutely nor as surely as I would have wished. My search was not long. The first sound that struck my ear was a flash of lightning. I perceived, suddenly, that it was not a single /sound/ for it made the impression on me that it was a composite /sound/... I called the first sound or generator a *fundamental sound*, its concomitants *harmonic sounds*.<sup>19</sup>

Thus had he felt the necessity to search outside of himself—in “nature”—for a principle more objective than habit, taste, or even current musical practice. And Rameau was the first to do this. As Cecil Grant has said:

...the age of Rameau's work represents a chronological line of demarcation in the history of theory...the attainment of unity seems to have become...both a goal and an obligation for any credible theorist after Rameau... Rameau's search for unity seems to have become a permanent component of the modern definition of music theory and to have made it, in that sense, forever “rational.”<sup>20</sup>

That his efforts in this direction were not entirely successful perhaps goes without saying, but in the very way in which he defined the task for himself, Rameau effectively redefined the nature of music theory itself. In this sense one might say that we are *all* “his successors.”

The “fundamental sound” (or what I will hereafter call the harmonic *root* of a simultaneous aggregate) thus became for Rameau a kind of “first principle,” from which he believed a complete and objective theory of harmony might be derived. As such, it conditions nearly every aspect of his conceptual universe—including, of course, his conception of consonance and dissonance. This “source” (whether by way of the first integral divisions of a string or as low-order harmonic partials of that string) is conceived as “generating” not only the consonances but the dissonances as well:

The same source that generated the consonances also generates the dissonances. Everything is related to this first and fundamental sound. From its division all intervals are generated and these intervals are such only with respect to this first sound... We must conclude...that dissonance has only one source.../and/ that, as the source is itself perfect and is the source of both consonances and dissonances, it cannot be regarded as dissonant. Consequently a *dissonance may reside only in the sound which is compared to the source* [my emphasis].<sup>21</sup>

Note here that the entitive referent for the word ‘dissonance’ is clearly an individual tone, not the dyad it forms with another tone. More specifically, it must be a tone which does not represent the harmonic root of the chord, and

this root must therefore be *identified*. In order to do this, however, another general theoretical concept is required—that of chordal *inversion*. As noted earlier, the application of this concept to the triad had already been at least implicit in the writings of Lippius and other theorists of the early 17th century, but Rameau extended it to the seventh chord as well, a chord which he considered as important—and treated as referentially (especially in the form we now call the “dominant seventh”)—as the triad itself. Taken together, these two general concepts (i.e. harmonic root and chordal inversion) make it possible to identify the dissonant note in the seventh chord—and for Rameau it was essential that it be identified, in order that the rules for the resolution of the dissonance in the various forms of the seventh chord might be reduced to some rational principle. In *Génération Harmonique* (1737), he speaks of this as follows:

The inversion of harmony... will show that any possible minor dissonance is nothing but the proposed seventh. The different names the seventh receives in inversion come only from its being compared with sounds other than the fundamental. Thus it receives the name of the interval it forms with one of these other sounds.<sup>22</sup>

Even here, the word ‘dissonance’ refers to an individual note, not to an interval, since it (the seventh) “receives the name of the interval it forms...,” and this is confirmed even more clearly in the passage immediately following the one just quoted from the *Treatise*...

...a dissonance may reside only in the sound which is compared to the source. This truth becomes even more patent when we consider that the rules about preparing a dissonance by syncopating it and resolving a dissonance by making it descend affect only the upper sound of the seventh, and not the lower sound which is the source... This is proof that the rule concerns only the dissonant sound and not its source... Thus, when the bass is syncopated under the second, the sound in the bass is actually the dissonant sound and must submit to the rule.<sup>23</sup>

From now on, I will refer to Rameau’s way of using the word ‘dissonance’ to mean “dissonant note” as the *dissonant-note concept*. As I suggested at the end of Section III, it marks the beginning of a radically new conception of consonance and dissonance—even though Rameau himself was evidently unaware of this fact. Just as with the root concept, he seems to have assumed that the dissonant-note concept was understood in the same way by theorists as far back as Zarlino, and that he (Rameau) was merely *applying* it more consistently. How else can we comprehend his seemingly beligerent attacks on those earlier theorists—to whom he knew he owed so much—as in passages like the following:

All those who have hitherto wished to prescribe the rules of harmony have abandoned the source of these rules. As the first sound and the first chord revealed to them was given

no sort of prerogative, everything was considered to be equal. When they spoke of the order of perfection of consonances, this was done only to determine which consonances were to be preferred when filling in chords. When they gave some reasons for a specific progression of thirds and sixths, this was done only by means of comparisons. When they finally reached dissonances, everything became confused: the second, the seventh, and the ninth. When they said that dissonances should always be prepared, they gave rules to the contrary; when they said that dissonances should all be prepared and resolved by a consonance, they contradicted this elsewhere. No one said why some dissonances wish to ascend and others to descend. The source was hidden and everyone, according to his own inclination, told us what experience had taught him... Hence the obscurity of the rules that have been given to us.<sup>24</sup>

If we assume that Rameau really believed that these earlier theorists were using the word ‘dissonance’ in the same way that he was using it here—to mean “dissonant note”—then we can see such attacks on his predecessors not as the self-serving polemics they might otherwise seem to be, but as sincere expressions of bewilderment at what seemed to him to have been an unnecessary confusion.

There may be several plausible reasons why Rameau assumed that the dissonant-note concept was already known and used by earlier theorists. One of these was indicated in Section III, where it was shown that an inherent ambiguity in figured-bass notation had led to an entitive use of ‘consonance’ and ‘dissonance’ to mean the upper note of a consonant or dissonant dyad (“the note figured”). In a sense, then, it would seem that Rameau simply misinterpreted the writings of earlier theorists in this respect—although it should be remembered that this had been a verbal convention for over a hundred years! But another, more positive reason may be adduced here as well. In 17th-century figured-bass treatises, a “dissonance”—even when it meant the upper note—was always understood to contribute to the dissonant quality of the dyad in which it occurred. Until that figured note was actually played, there was no dissonance—and this was so regardless of the fact that specific rules for the differential treatment of the notes forming the dissonant dyad had already become well established. In a sense then, Rameau’s “innovation” amounted to nothing more than postulating a fixed *correlation* between ‘dissonance’ (as “dissonant note”)—on the one hand, and on the other—that particular note which was required by the rules to effect the resolution. Or—to put this another way—whereas “a dissonance” had already come to mean a note which forms a dissonant interval with the *bass*, in Rameau it became a note which forms a dissonant interval with the *fundamental bass*—and this involved only a very subtle semantic transformation. The new conception of consonance and dissonance grew out of CDC-3 in a very natural way, and in its earliest manifestations led to results which were, in most respects, quite consistent with those derived from CDC-3. The fact that it was indeed a new conception was not immediately obvious—and its innovative character seems to have gone essentially unnoticed until the present.

Many of the unique aspects of Rameau's theoretical system were not accepted by contemporary figured-bass theorists, partly because they felt no need for such radical new notions. The great composers of the High Baroque (including Rameau himself) had learned their craft from treatises based on 17th-century practices and theoretical concepts, and these were perfectly adequate pedagogical vehicles for the teaching of the fundamentals of Baroque style. It was not until the work of Marpurg and Kirnberger in the second half of the 18th century that Rameau's theories began to be integrated into practical treatises—and by then the Baroque style was already a thing of the past. The new "Classical" style was in full flower, and Rameau's simplifying generalizations were now extremely useful. In this sense—and perhaps for the first time in history—theory was significantly *ahead* of practice. And yet, as early as the middle of the 18th century, the dissonant-note concept had already been assimilated by many other theorists—including some of Rameau's severest critics and most adamant theoretical opponents. Thus, for example, in his *Essay on the True Art of Playing Keyboard Instruments* (Part Two, 1762), C.P.E. Bach writes:

The basic characteristics of dissonances are suggested by their name, which expresses the fact that they sound bad. From this it follows that they may be used only under certain conditions. Their natural harshness must be mollified by preparation and resolution; that is, *the dissonant tone must be played, previously, as a consonance* and it must succeed to a consonance. By itself, a dissonant tone is sufficiently disagreeable; hence it is wrong to double it; moreover, because it must be resolved, doubling would induce forbidden octaves [my emphasis].<sup>25</sup>

and in his *Dictionnaire de Musique* (1768), Jean-Jacques Rousseau defines 'dissonance' as follows:

Every sound which forms with another a disagreeable combination to the ear, or better, every interval which is not consonant. Thus, as there are no other consonances than those which form among themselves and with the fundamental the sounds of the perfect chord, it follows that every other interval is a true *dissonance*... One gives the name of *dissonance* sometimes to the interval and sometimes to each of the two sounds which form it. But although two sounds dissonate between themselves, the name of *dissonance* is given more especially to that one of the two which is foreign to the triad.<sup>26</sup>

Because of his commitment to the idea that "melody arises from harmony,"<sup>27</sup> Rameau avoided descriptions of chordal structure based on purely melodic considerations, preferring instead to search for an explanation of every kind of dissonant note by way of the process of "harmonic generation." This limited the range of dissonance forms which could be accounted for in his theory. In the works of Johann Philipp Kirnberger, this limitation was removed—and the dissonant-note concept made more sensitive to melodic and other "horizon-

al" considerations—by distinguishing between two types of dissonance: "essential" (*wesentlich*) and "non-essential" (*zufällig*). In *The True Principles for the Practice of Harmony* (1773), these terms are explained as follows:

All harmony is based on just two fundamental chords... These are: (a) the consonant triad, which is either major, minor, or diminished [!]; and (b) the dissonant essential seventh chord... In the progression from one chord to another, each note that belongs to the above-mentioned chords... can be delayed by a tone that precedes it... This tone becomes dissonant and must resolve shortly thereafter to its essential position... This results in a number of dissonant chords that resolve to the same fundamental chord, in relation to which they are considered suspensions... All dissonances that arise in this manner from suspensions are called non-essential *aby* us to distinguish them from the dissonance of the seventh, which we call essential. The former are most dissonant against the note they displace, and their most perfect resolution occurs over the same bass to the fundamental chord. The essential seventh, on the other hand, is not dissonant because it has taken the place of a consonance; rather it is dissonant because it has been added to consonant intervals, thus disrupting the consonant harmony of the triad, or at least making it very imperfect. Since it does not substitute for another note belonging to that bass note, it cannot resolve over the same fundamental bass, but absolutely requires an entirely different harmony for its resolution. Herein lies the distinction between nonessential and essential dissonance.<sup>28</sup>

With this important refinement by Kirnberger, the dissonant-note concept has become an inseparable component of triadic-tonal harmonic theory, although it is seldom clearly distinguished from other consonance/dissonance concepts. Or, when it is so distinguished, it is all too often treated as though—being the basis for the only "true" meaning of 'consonance' and 'dissonance'—it ought to *replace* those other concepts. Consider, for example, Hugo Riemann's definition of 'dissonance' in his *Dictionary of Music* (1908):

*Dissonance*... interference with the uniform conception (consonance) of the tones belonging to one clang [i.e. a major or minor triad], by one or more tones which are representative of another clang. *Musically speaking, there are not really dissonant intervals, but only dissonant notes* [my emphasis]. Which note is dissonant in an interval physically (acoustically) dissonant, depends on the clang to which that interval has to be referred... By thus distinguishing dissonant... notes in place of the old system of intervals and chords, a much clearer view of chords is obtained. *Every note is dissonant which is not a fundamental note* (unchanged), *neither third or fifth of the major or minor chord forming the essential elements of a clang* [Riemann's emphasis].<sup>29</sup>

But whereas the advantages of the dissonant-note concept in CDC-4 are con-

siderable, and it is quite appropriate in discussions of "common practice" or functional harmony, Riemann's claim here that "musically speaking, there are not really dissonant intervals..." is clearly insupportable in view of the long and venerable history of earlier forms of the CDC.

The dissonant-note concept has not only come to be taken for granted by theorists since Rameau; it is frequently applied in an anachronistic or ahistorical way to statements by theorists preceding Rameau, to whom it would have been an utterly alien conception. For example, in F. T. Arnold's exhaustive survey of figured-bass treatises,<sup>30</sup> I have found three instances where he uses it to amend or correct what he obviously assumes to be merely inadvertent "omissions" by 17th and early 18th-century theorists. In his discussion of Johann Staden's treatment of "discords" in a treatise of 1626, Arnold says:

Staden begins by giving examples, in two parts only, of the discords in question... In the case of the Second, *he fails to explain that it is not the Second itself, but the Bass which is dissonant*, and therefore requires preparation, though the examples make this plain [my emphasis].<sup>31</sup>

Again, regarding a statement by Friderich Niedt (1700) to the effect that "When a note is figured  $\frac{4}{2}$  or  $\frac{6}{2}$ , there is no preparation... 'it is a chord of simple percussion'...", Arnold's comment is:

N.B.—Niedt omits to mention that the Bass itself, as the discordant note, requires preparation.<sup>32</sup>

And finally, in his discussion of the *Traité de l'accompagnement du clavecin...* (1707) by Michel de Saint-Lambert—after paraphrasing this writer's admonition that "Above all, one must never double dissonances, except the Second," Arnold adds, in a footnote:

It is, of course, not the Second itself but the Bass which is the dissonant note.<sup>33</sup>

Thus, Arnold interprets 'dissonance' in all three of these treatises to mean "dissonant note"—and that may, in fact, have been what these theorists meant—but *not* in the sense in which Rameau was to define it only later. They were simply using it as an abbreviated reference to the upper note of a dissonant dyad. The very fact that Arnold seems unaware of the ahistorical nature of his own remarks here is perhaps as interesting and significant as the evidence those remarks provide that these earlier theorists were not yet making the kind of distinction which Arnold (and Rameau) took for granted.

At the risk of belaboring this point, I must point out that Arnold is not the only important 20th-century scholar who has thus used the dissonant-note concept anachronistically in discussions of pre-18th-century musical theory and practice. In his penetrating study of 16th-century polyphony, *The Style of Palestrina and the Dissonance*, Knud Jeppesen comments on statements by the 15th-century theorist Guilielmus Monachus regarding the resolution of certain dissonant dyads as follows:

When Guilielmus for instance teaches that the 2nd resolves into the "low" 3rd, (*this being most likely rather an awkward way of expressing that the dissonance should be placed in the lower voice*), or that the 7th resolves into the 6th and the 4th into the "high" 3rd, (*meaning that the dissonance should be in the upper voice*), he herewith gives the very best and most commonly used resolutions possible to the syncope dissonance [my emphasis].<sup>34</sup>

But these observations by Guilielmus were surely not "an awkward way of expressing" anything other than the fact that these were the standard ways of resolving each of these dissonant *dyads*. For a 15th century theorist, the word 'dissonance' (in its entitive sense) meant simply that—a dissonant dyad—not a dissonant note, as it does here to Jeppesen. This latter term, in fact, would have been quite meaningless to Guilielmus. And it would have remained equally meaningless to a theorist of the 16th century—which is the period of primary concern to Jeppesen. The sort of theoretical anomaly that may follow from an application of the dissonant-note concept to 16th-century musical practice is indicated by another statement of his about a type of unprepared dissonance not uncommon then:

In all the dissonance forms hitherto mentioned in this treatise, there was no doubt about which note was the dissonance. The dissonance was always placed against a greater note value; the shortest of the notes which met in this dissonant relation was always understood as the dissonance, and it lay with the voice introducing the latter to provide for its correct continuation... But here it is different—for which note should be considered the dissonance... or are they both to be regarded as such, with the consequent obligations?<sup>35</sup>

I hope it will have become clear by now that the conception of consonance and dissonance implicit in such passages was only first introduced into music theory by Rameau in the early 18th century, and consequently that such questions as these by Jeppesen would simply not have arisen in the mind of a theorist or composer of the 15th or 16th (or even the 17th) century.

Rameau's interpretation of the word 'dissonance' as "dissonant note" (and by implication, of 'consonance' as "consonant note") has thus survived (for better or worse) well into the 20th century. This is not the case, however, with certain extensions of the dissonant-note concept which Rameau went on to elaborate. In the *Treatise...* he draws a distinction between two species of dissonant note—the "minor dissonance" (the minor seventh in the dominant seventh chord) and the "major dissonance" (the major third in that same chord). These terms are explained there as follows.

The first dissonance is formed by adding a third to the perfect chord, and this third, measured from the fifth of the lowest sound of the chord, should naturally be minor. If this added third then forms a new dissonance with the major third of the lowest sound of this same chord, we see that dissonance is derived from these two thirds, and we are consequently

obliged to distinguish two types of dissonance. We call that dissonance which arises from the added minor third minor, and that which arises from the natural major third of the perfect chord major. This is a distinction which has not yet been made [by earlier theorists] but which is nonetheless very reasonable, for by this means we may at once determine the progression of all dissonances. Major dissonances must ascend, while minor dissonances must descend.<sup>36</sup>

Fifteen years later, in his *Génération Harmonique*, he adds the following:

When the minor dissonance is joined to the dominant harmony, which always has the leading-tone as its major third, it communicates part of its harshness to this leading-tone, so that, to satisfy the ear, the succession of both becomes obligatory [my emphasis].<sup>37</sup>

Here, the quality of “harshness” is deemed to reside initially in the upper note, and then to be partially “communicated” to the lower note of the dyad—or at least Rameau writes here *as if* this were the case. In fact, this lower note really has only a conditional and secondary dissonant status, even for him, since he had said earlier (in the *Treatise*...):

The major dissonance is not dissonant in itself, while the minor is. If we suppress the latter, there will no longer be a major dissonance...<sup>38</sup>

and it is perhaps for this reason that his distinction between these two types of dissonant note has not survived in later theory. Kirnberger (though without adopting Rameau’s terminology) made a similar distinction between rising and falling “leading tones,” and treated them both *like* dissonances in certain respects (e.g. neither was to be doubled), but he was “equivocal” (as Cecil Grant has put it<sup>39</sup>) about actually calling the first of these an outright dissonance. Similarly, while Francois-Joseph Fétis (in 1867)<sup>40</sup> calls the augmented fourth and diminished fifth “*intervalles attractifs*” because of their tendencies toward resolution as part of the “natural dissonance” of the dominant seventh chord, he ascribes this “attractive” quality to the intervals, rather than the notes themselves—and he actually classifies these intervals as consonances.<sup>41</sup> Thus, although Rameau found this distinction between two types of dissonant note both useful and “reasonable,” it does not seem to have survived in the writings of any major theorist since Rameau.

In order to distinguish more clearly this new conception of consonance and dissonance first articulated by Rameau from the several earlier forms of the CDC which are also present in his writings—often mixed together indiscriminately in the same sentence or paragraph—it will be useful to formulate our own “implicit” definitions of ‘consonance’ and ‘dissonance’ in CDC-4, somewhat as follows: in the entitive sense, a “consonance” (or consonant note) is any note which is related as prime, third, or fifth to the harmonic root of a chord; a “dissonance” (or dissonant note) is one which is not so related. By extension (but still strictly within CDC-4), a consonant *chord* would then

be a chord *containing only consonances* (i.e. consonant notes), and a dissonant chord one *containing one or more dissonances* (i.e. dissonant notes). It should be noted that—with such definitions—‘consonance’ and ‘dissonance’ may no longer bear any direct relationship to the “sonorous quality” (or even to the “functional behavior”) of the aggregate in which these notes occur. Their consonant or dissonant status is completely determined by the *structure* of the aggregate in relation to its harmonic root, and this structure is specified by the identification of each of its constituent tones—as root, third, fifth, or “other.” These, of course, are mutually related in such a way that the identification of any one of them automatically serves to identify all of the others, but *one*, at least, must be able to be identified *unambiguously*; otherwise the whole system breaks down. These “implicit” definitions of ‘consonance’ and ‘dissonance’ will not account for Rameau’s extension of the dissonant-note concept to include the two distinct species—“major” and “minor” dissonances—since the major third in the dominant seventh chord only acquires whatever dissonant status it might have by virtue of its relation with the minor seventh, rather than with the root, but I think they will account for those aspects of the dissonant-note concept which have survived in later manifestations of CDC-4.

If the entitive referents of ‘consonance’ and ‘dissonance’ are thus to be individual notes in a chord, what *qualitative* definitions does this imply? In particular, what quality or property is carried by a dissonant note? Rameau speaks of its “harshness,” and C.P.E. Bach calls it “disagreeable,” but these surely refer to a quality of the aggregate as a whole—in the sense of CDC-2 or CDC-3—rather than to the note itself. On the basis of the entitive definitions suggested above, however, we can say (to begin with) that the property in question is simply an “existential” one—that of *being* something other than prime, third, or fifth of a triad. But in addition—and by the very nature of its historical genesis—a dissonant note is the *agent* responsible for the creation of a condition of dissonance (in the sense of CDC-2 or CDC-3), and as such, it carries the responsibility for the removal of this condition—an *obligation to effect the resolution* of the dissonance. Thus, the “dissonant” quality which is carried by a dissonant note must also include this “obligation” (which will later be called—rather anthropomorphically—a “tendency” or “need”) to resolve—which is to say—to *move*. And it is here, I think, that we can locate the unique and precise point of origin of two notions which are currently held by many theorists—and which are completely at odds with earlier forms of the CDC: (1) that there ought to be an absolute *dichotomy* between consonance and dissonance, and (2) that they involve merely “phenomena of motion,” “stability/instability,” etc., in a way that is entirely divorced from any acoustical or immediate sensory properties of the isolated sound or sound-aggregate. Concerning the first of these, it should be recalled that neither CDC-2 nor CDC-3 involved such a clear-cut dichotomy; in CDC-2, a graded continuum was always assumed, but even in CDC-3 a distinction was made between degrees of consonance, if no longer of dissonance. In CDC-4, in the other hand, a tone either *is* or *is not* a triadic component (assuming that the root of the triad is known); there are no “degrees” of satisfaction of this criterion.

Regarding the second point (“phenomena of motion”), note that in earlier

contrapuntal theory (i.e. in CDC-3), dissonance occurred as a kind of necessary *result* of melodic motion in one or more of the parts—as we saw, for example, in this passage from Zarlino quoted earlier (p. 52):

...intervals that are dissonant produce a sound that is disagreeable to the ear and render a composition harsh and without any sweetness. Yet it is impossible to move from one consonance to another, upward or downward, without the means and aid of these intervals [my emphasis].<sup>42</sup>

For Zarlino, in fact, if anything carried an “obligation” or “tendency toward motion” even remotely resembling that associated with dissonances in CDC-4, it was the *imperfect consonances*, as we see in the following:

...imperfect consonances have this feature: their extremities tend in the direction of the nearest perfect consonance rather than toward more distant ones...the imperfect major intervals desire to expand, and the minor have the opposite tendency.<sup>43</sup>

and again, in a later passage:

If the second and seventh, though dissonant, are tolerable in syncopation, how much more tolerable is the sixth, which far from being dissonant, is accepted by all as a consonance! Someone might say that with this precedent we should also permit the minor sixth to go to the octave. I should reply that *this is contrary to its tendency*. While the major sixth tends to go to the octave, which is closest, it is nevertheless closer to the fifth than the minor sixth is to the octave. *The tendency is for an imperfect consonance to move to the nearest perfect consonance* [my emphases].<sup>44</sup>

In CDC-4, of course, such “tendencies” are ascribed no longer to imperfect consonances, but to dissonant notes—as we saw earlier in Rameau’s prescription that “major dissonance must ascend, while minor dissonance must descend”—and in fact, it was these very same statements by Zarlino which Rameau invoked in order to justify this rule. Thus, in CDC-4, dissonance is no longer the “result” of melodic motion, but one of its primary *causes*. In addition, this association of dissonance with motion gradually begins to reflect back on the consonance/dissonance concept in such a way that, if a note is judged to have a strong tendency toward motion—for whatever reason—it may therefore come to be called “dissonant.” According to Grant, Kirnberger was on the brink of such a point when he wrote (in the *Generalbasses*, 1781):

The leading tone, which, as the major third of the dominant chord, must rise, would place the listener in the greatest disquiet if one omitted its succeeding chord, although no dissonant interval occurs in the triad on the dominant, but perhaps merely *the impression of a dissonance* [Grant’s emphasis].<sup>45</sup>

and Grant says that:

By “the impression of a dissonance” Kirnberger clearly means the leading tone’s tendency to rise...<sup>46</sup>

But as noted earlier in connection with Rameau’s definitions of “major” and “minor” dissonances, Kirnberger stopped short of calling the third of the dominant chord a dissonance—even when the chord also contained the seventh. Grant’s discussion of Kirnberger’s position here is of considerable interest in relation to the larger questions addressed in this book:

Kirnberger’s problem in granting the leading tone dissonant status stems from his intervallic definition of dissonance. He and his contemporaries inherited the traditional view that certain intervals are *innately* consonant, others are *innately* dissonant, and that any dissonance theory must somehow relate to intervallic content *per se*. This is, in itself, a restrictive, deductive presumption, implying an *a priori* definition of dissonance. Kirnberger is able to explain his two formally sanctioned dissonance types in such intervallic terms; accidental [“non-essential”] dissonances obtain their dissonance by comparison to the tones which they replace at a distance of a second, while the essential seventh forms a classically dissonant interval with the fundamental to which it is related, albeit at the octave. The leading tone, however, will not conform to either of these proofs. It is unquestionably an essential part of the chord, so it must be compared with its root; yet comparing it with that note produces the strong consonance of a major third... Kirnberger’s reaction to this dilemma brings to light the dual definition of dissonance implicit in some of his remarks. At times, his vertical perception of intervallic dissonance gives way to a perception based upon melodic “tendency,” or predictable melodic movement.<sup>47</sup>

Here Grant is quite clearly making the same distinction I have been making as between CDC-4 and earlier “intervallic” forms of the CDC, but he seems a bit puzzled by Kirnberger’s adherence to such a “restrictive...assumption.” Yet Kirnberger’s ambivalence here is hardly surprising in the light of the fact that this “traditional view” of consonance and dissonance had not even been *questioned* by theorists before the time of Rameau, and Kirnberger was by no means an avid disciple of his French predecessor. In the wake of Rameau’s work, a gradual transformation in the meaning of ‘consonance’ and ‘dissonance’ was indeed taking place, but Kirnberger was working in a transitional period, during which it still seemed necessary to derive the behavioral characteristics of a dissonant note from the perceptible properties of the interval it formed with another note. He tried to solve the problem by reference to the (melodic) “dissonance” (CDC-1?) between the leading tone and the tonic note to which it “tends” to move, but as Grant says:

[His] explanation is hardly convincing. Kirnberger’s view of dissonance has always been vertical rather than successive

or horizontal; he has established dissonant chords, not dissonant successions. Unsatisfactory as is his application of a melodic explanation to an essentially harmonic problem, it is the only available solution to his problem in establishing dissonance in a chord which, by all previous definitions, should be consonant.<sup>48</sup>

By the middle of the 19th century, this association of 'consonance' and 'dissonance' with 'phenomena of motion' had attained such an autonomy in the minds of some theorists that it could seem to them the only valid basis for the definition of these terms. From a broader historical perspective, of course, we have seen that it is merely *one of several* such bases.

The possibility provided in CDC-4 of identifying the dissonant note in a chord had the immediate advantage that it reduced to a single principle many of the separate rules for dissonance-resolution which had emerged in figured-bass practice. And its results were—in most cases—not only consistent with that practice, but *internally* consistent as well. But since the identity of the dissonant note (or of *any* note, for that matter) depends entirely on its relation to the harmonic root of the chord in which it occurs, any ambiguity regarding this root automatically affects the identification of the dissonant note. Such ambiguities arise with the chord of the "added" or "large sixth," the diminished seventh chord, chords of the 9th, 11th, etc., and the six-four chord (although Rameau did not consider this last one to be ambiguous). The first of these chords constituted a persistent and difficult problem for him, which he tried to solve in several different ways. In the *Treatise...*, he writes:

...in the chord of the large sixth there are three consonances: the third, the fifth, and the sixth, but we shall find a dissonance between the fifth and the sixth. Thus, these consonances are dissonant with respect to each other. To distinguish the consonance which actually forms the dissonance, we need only relate these chords to their fundamental. We shall see then that...in the chord of the large sixth the fifth [forms the dissonance]; for...this fifth [is] actually the seventh of the fundamental sound of the seventh chord, from which [this chord is] derived...<sup>49</sup>

But when this chord occurs on the first or fourth degree of the (major) scale, this explanation is no longer valid, since:

We must make an exception for the chord of the large sixth formed by adding a sixth to the first perfect chord of an irregular cadence [i.e. in a IV-I or I-V progression.]. Here the perfect chord should be the sole object of our attention, for the seventh chord has no place in this cadence; the dissonance is formed by the added sixth.<sup>50</sup>

As Manfred Bukofzer has noted:

Rameau fell into inconsistencies which show him still imprisoned in continuo thinking. His manner of figuring the

fundamental bass and that of "adding" tones to triads (*Sixte ajoutée*) represent vestiges of the continuo practice which have survived even to the present day in such terms as sixth chord.<sup>51</sup>

Examples of such "vestiges" are to be found in the *Treatise...* especially in cases like this where his new concepts could not easily be made to account for some important aspect of harmonic practice. But even though Rameau is sometimes forced to explain the behavior of a dissonant note on the basis of disparate principles, the dissonant-note concept itself remains intact, as in the following:

There is a new dissonance here which has not been discussed...This dissonance is not dissonant with respect to the bass. It is a sixth which is consonant but which forms a dissonance with the fifth of the bass. This dissonance must thus be resolved by ascending...Although this chord may be derived naturally [i.e. by inversion] from the seventh chord, here it should be regarded as original. On all other occasions, however, it should follow the nature and properties of the chord from which it was first derived.<sup>52</sup>

The process of identification depends here not only on the structure of the chord, but on its tonal function, and thus on the context in which it occurs. Later—in the *Nouveau Systeme...*, Rameau was to write:

...a chord in which the sixth is added must never be reduced to a combination in which the seventh is heard above the bass, because the seventh chord, being the first of its kind, cannot be reproduced by the one which itself is a product of it. Thus...it is only by the fundamental progression that one can distinguish it. Therefore the necessity of knowing this fundamental progression is more and more perceptible [my emphasis].<sup>53</sup>

Rameau's ideas about the subdominant were conditioned by a severe (and probably unnecessary) constraint that he had imposed on himself in the *Treatise...*—that the most natural progression of the fundamental bass should involve only consonant intervals—and primarily the (descending) fifth. In order to account for the apparent violation of this principle by the frequent occurrences of the IV-V progression in current practice, he invented a new concept—the *double emploi*—which allowed for two alternative interpretations of the "added sixth" chord on the fourth degree. According to context, it might either be a IV chord with added sixth, or a seventh chord (in first inversion) on the supertonic. Thus, in *Génération Harmonique*, he says:

While we believe we are only adding a dissonance to the subdominant, we are presenting it with a new fundamental sound, to which it can lend its whole harmony, while sustaining it in this way. From this comes the *double emploi* in this same sub-dominant harmony. That is, depending on circumstances, the sub-dominant note will be fundamental, or it will cede

this right to its own dissonance [my emphasis].<sup>54</sup>

Again, the harmonic interpretation of the chord would depend not merely on its structure but on “circumstances”—i.e. context—and this is the important thing to note in *all* of these attempts by Rameau to deal with this chord; they each invoke musical context as a kind of last resort. Whereas in the initial formulation of CDC-4, the consonance or dissonance of a note would be determined solely by the structure of the chord in which it occurs, the very fact that the harmonic root is not always unambiguous *requires* a consideration of context and tonal function. These factors will become even more important in Kirnberger and later theorists, but they are already present in some degree in Rameau—in spite of his obvious desire to keep his theory purely “structural.”

In Kirnberger’s work, a similar ambiguity with respect to harmonic root arises with the six-four chord, but he dealt with it in a very different way than Rameau might have (if he had recognized any such ambiguity at all in this chord, which he did not). In *The True Principles...*, Kirnberger says:

...it is evident that all intervals, even those that are originally consonant, can become non-essential dissonances when they are displacements of notes necessary to the fundamental chord. Thus there are two types of six-four chord, namely the consonant, which is the second inversion of the triad, and the dissonant, where the sixth displaces the fifth and the fourth displaces the third. These two types must be distinguished from one another, since they differ with respect to fundamental harmony and, therefore, with respect to treatment... *The real root of [the] dissonant six-four chord is the bass note...* Those who have a feeling for a correct progression of the fundamental harmony need only pay attention to the fundamental bass in order to distinguish the dissonant from the consonant six-four chord. And thus an end would finally be put to the eternal dispute—whether the fourth is consonant or dissonant, whether it is now a fourth or an eleventh—about which so many written wars have been waged with unspeakable bitterness without anything having been settled [my emphasis].<sup>55</sup>

The consonant or dissonant status of this chord thus depends on which note is taken to be the “real root”—the bass note or the note a fifth below—but this, in turn, depends on function and context.

In fact, it can be stated very generally that—in CDC-4—an appeal to these factors must inevitably be made in order to determine the consonance or dissonance of a note in *any* chord whose harmonic root is ambiguous. The reasons for this ambiguity may differ, but the result is the same. In the case of the “added sixth” chord, the ambiguity is inherent in the structure of the chord, and an appeal to context is required in order to resolve the question. In the case of the six-four chord, on the other hand, the argument for root-ambiguity is based on context to begin with, and this is then used to redefine the nature (if not the structure) of the chord. Once it has been decided that the lower note in the six-four chord is the “real” harmonic root, the fourth

and sixth above that root become dissonant notes—and the chord a dissonant chord (in CDC-4)—in spite of the fact that it is clearly consonant from the standpoint of sonorous quality.

It is interesting to note here too, that—for Kirnberger—this distinction between consonant and dissonant six-four chords constituted an answer to the centuries-old question regarding the status of the perfect fourth. Expressed in terms of my own definitions of ‘consonance’ and ‘dissonance’ in different forms of the CDC, he seems to be saying that—while the fourth is a consonance (i.e. a consonant dyad, in CDC-2), its upper note is a dissonance (i.e. a dissonant note, in CDC-4) when the lower note is taken to be the harmonic root. This is an interesting hypothesis, although as I suggested in my discussion of this question in Section III, it would require the assumption that the sense of harmonic roots—and even some form of the dissonant-note concept—were already affecting musical perception as early as the 14th century. Since I have found no clear-cut evidence for such an assumption, I prefer the alternative explanation of the fourth’s dissonant treatment in CDC-3, as outlined in Section III.<sup>56</sup>

The extent and nature of the context involved in decisions regarding consonance and dissonance varied considerably in the course of development of CDC-4 during the 18th and 19th centuries. In Rameau this context is generally limited to the immediate environment of a note or chord, whereas by the late 19th century it could be extended to include—potentially—*everything* that had gone before, insofar as this might have been involved in establishing a sense of the tonic or key-center. One effect of such an extension on the conception of consonance and dissonance is suggested by the following passage from “The Nature of Harmony” (1882) by Hugo Riemann:

...the only consonant chord in any key, in the strictest sense of the term, is the tonic chord... In C major, the chord of G is not a perfect consonance... Nor is the chord of F major a true consonance in the key of C... The effect of these chords is *dissonance-like*; or better, the perception of them contains something which disturbs their consonance; and this something is simply their *relation* to the chord of C major... when I imagine the chord of G major as in the key of C, then... the chord of C major forms a part of the conception, as being the chord which determines the significance of the chord of G... The central point of the idea, so to speak, *lies outside* of the chord of G; there is in that chord an element of unrest; we feel it necessary to go on to the chord of C as the only satisfactory point of repose. This element of dissatisfaction constitutes dissonance.<sup>57</sup>

A comparison of this statement with a related passage by Rameau will show the extent of the change in the CDC implied here by Riemann. Rameau had said (in the *Treatise...*):

Of the two sounds in the bass which prepare us for the end of a piece, the second is undoubtedly the principle one, since it is also the sound with which the whole piece began. As

the whole piece is based on it, the preceding sound should naturally be distinguished from it by something which renders this preceding sound less perfect. If each of these sounds bore a perfect chord, the mind, not desiring anything more after such a chord, would be uncertain upon which of these two sounds to rest. Dissonance seems needed here in order that its harshness should make the listener desire the rest which follows.<sup>58</sup>

A certain way of using consonance and dissonance is thus recommended as a means of *establishing* the tonic, whereas for Riemann the tonic has become referential in the very *definition* of 'consonance' and 'dissonance'. The consonant or dissonant status of a chord would now be determined not by its content (i.e. by the status of the notes it contains) but by the relationship between its harmonic root and the tonic of the piece (or extended passage) in which it occurs. This constitutes a very considerable extension or transformation of the conception of consonance and dissonance first articulated by Rameau, and would have to be recognized as a new form of the CDC if it had gained any widespread currency among later theorists, but it does not appear to have done so.

The shadow of Jean-Philippe Rameau looms large in the history of harmonic theory since the mid-18th century, and the concepts first clearly formulated by him remain visible even in the writings of theorists who were unwilling to acknowledge their debt to him. There are, of course, many important theoretical problems associated with the triadic-tonal system which were not solved by Rameau in a way which could be accepted unequivocally by later theorists. One of these has already been mentioned—the problem of root-ambiguity in the chord of the "large sixth." Another problem which remained unsolved by Rameau—although he grappled with it throughout his entire career—involves the question of the "origin" of the minor triad. But it is doubtful that such problems have been adequately solved by any theorist *since* Rameau either. As Matthew Shirlaw has said:

Rameau's influence has been widespread and powerful, and even those who have rejected his doctrines have not hesitated to borrow his principles.<sup>59</sup> /and later/... In his endeavours to demonstrate the truth of his principles, Rameau encountered serious difficulties. These difficulties none of his successors have been able to remove. It may be partly owing to this fact that theorists, at the present day [1917], are forsaking acoustical phenomena, and turning towards psychology for an explanation of the problems connected with harmony. But it should be noted not only that psychology has its own problems, but that psychologists are seeking in music and harmony (consonance) and its effects on the mind, for a solution of some of these problems. It may prove eventually that, instead of musical theorists finding their difficulties removed by means of the science of psychology, psychology itself will be advanced by means of discoveries made in the domain of the theory of harmony.<sup>60</sup>

The full implications of these last remarks by Shirlaw have barely begun to be appreciated.

## Section V

### Helmholtz and the theory of beats (CDC-5)

It is unlikely that anyone's list of distinct conceptions of consonance and dissonance could ever be complete, especially with regard to music theory and practice in the 19th and 20th centuries, and I will not even attempt an exhaustive treatment of the subject for this more recent period. The distinctions that have already been made in this book will serve, I think, to clarify the semantic problems associated with 'consonance' and 'dissonance' quite considerably—and incidentally—to clear the way for some useful new theoretical formulations regarding the physical (or other) *correlates* of consonance and dissonance. There is, however, one additional form of the CDC which cannot be ignored, however much its relation to musical practice might be questioned, and that involves the correlation of consonance and dissonance with beats, proposed in the 19th century by the famous scientist, Hermann Helmholtz. In his classic work, *On the Sensations of Tone...* (1862), Helmholtz outlined a theory of consonance and dissonance which has survived to this day as the most prominent and frequently cited of all such theories—especially in the literature of psychoacoustics—in spite of the fact that it has provoked fierce controversy among music theorists. Our interest here, however, is not so much in the *theory* as such, as in the question whether its underlying *conception* of consonance and dissonance is identifiable with any earlier form of the CDC, or is a distinctly new one. This can only be inferred from Helmholtz's writings, and from certain implications of the theory itself, whether or not these are made explicit in those writings.

Helmholtz equates the dissonance of a simultaneous aggregate with the "roughness" of the sensation caused by beats between adjacent partials (and to a lesser extent, between "combinational tones") in the combined spectrum of the tones forming the aggregate. He says, for example:

When two musical tones are sounded at the same time, their united sound is generally disturbed by the beats of the upper partials, so that a greater or less part of the whole mass of sound is broken up into pulses of tone, and the joint effect is rough. This relation is called *dissonance*... But there are certain determinate ratios between pitch numbers, for which this rule suffers an exception, and either no beats at all are formed, or at least only such as have so little intensity that they produce no unpleasant disturbance of the united sound. These exceptional cases are called Consonances.<sup>61</sup>

He estimates that this roughness is maximal for beat rates of some 30 to 40 per second, and describes the perceptual effect of such roughness as follows:

In the first place the mass of tone becomes confused...But

besides this...the sensible impression is also unpleasant. Such rapidly beating tones are jarring and rough. The distinctive property of jarring is the intermittent character of the sound<sup>62</sup>...[and again]... A jarring intermittent tone is for the nerves of hearing what a flickering light is to the nerves of sight, and scratching is to the nerves of touch. A much more intense and unpleasant excitement of the organs is thus produced than would be occasioned by a continuous uniform tone.<sup>63</sup>

In a later passage, Helmholtz summarizes his beat theory as follows:

...it is apparent to the simplest natural observation that the essence of dissonance consists merely in very rapid beats. The nerves of hearing feel these rapid beats as *rough* and unpleasant, because every intermittent excitement of any nervous apparatus affects us more powerfully than one that lasts unaltered... The individual pulses of tone in a dissonant combination...form a *tangled* mass of tone, which cannot be analyzed into its constituents. The cause of the unpleasantness of dissonance we attribute to this *roughness* and *entanglement*. The meaning of this distinction may be thus briefly stated: *Consonance is a continuous, dissonance an intermittent sensation of tone*. Two consonant tones flow on quietly side by side in an undisturbed stream; dissonant tones cut one another up into separate pulses of tone. This description of the distinction at which we have arrived agrees precisely with Euclid's old definition, 'Consonance is the blending of a higher with a lower tone. Dissonance is incapacity to mix, when two tones cannot blend, but appear rough to the ear.'<sup>64</sup>

There is no doubt that what Helmholtz intended his theory to *explain* was what he took to be a (or rather, *the*) "traditional" conception of consonance and dissonance, as when he says:

The enigma which, about 2500 years ago, Pythagoras proposed to science, which investigates the reasons of things, 'Why is consonance determined by the ratios of small whole numbers?' has been solved...<sup>65</sup>

But a careful comparison of his own statements—and of certain implications of the theory—with what we know of each of the earlier forms of the CDC will show that there was a new form of the CDC underlying Helmholtz's theory—one which will hereafter be designated CDC-5.

First, it should be clear that we are not involved here with some variant of CDC-4, since Helmholtz's entitive referents are generally dyads or other simultaneous aggregates *isolated from any musical context*. He speaks of Rameau and his theories with great respect, and yet the dissonant-note concept as I have interpreted it does not play an important role in his own theoretical work; he treats it, in fact, as little more than a verbal convention, as in the following:

Those tones which can be considered as the elements of a compound tone, *i.e.* tones which are equivalent to low-order partials of a compound tone, as in a major triad] form a compact, well-defined mass of tone. Any one or two other tones in the chord, which do not belong to this mass of tone...are called by musicians the *dissonances* or the *dissonant notes* of the chord. Considered independently, of course, either tone in a dissonant interval is equally dissonant in respect to the other, and if there were only two tones it would be absurd to call one of them only *the* dissonant tone...[and thus]...although the expression is not a very happy one, we can have no hesitation in retaining it, after its real meaning has been thus explained.<sup>66</sup>

Now this seems to me an eminently logical explanation of the "real meaning" of the term, *dissonant note*, but it is not the meaning given to it by Rameau. Yet Helmholtz had been strongly influenced by Rameau's theories. He does not question the assumption—so clearly made possible only by the *separation* of the dissonant-note concept from considerations of sonorous quality—that a dissonant chord has some inherent tendency toward motion, as when he says of the dominant seventh chord:

As a dissonant chord it urgently requires to be resolved on to the tonic chord, which the simple dominant triad does not.<sup>67</sup>

and this in spite of the fact that he considers it to be "the softest of all dissonant chords."<sup>68</sup> But the form of the CDC implied by his beat theory has absolutely nothing to do with such tendencies toward motion, resolution, or chordal connections of any kind. It refers merely to the perceptual character of individual chords.

While it is fairly clear that a critical distinction can be made between CDC-5 and CDC-4, such a distinction between CDC-5 and CDC-1 is so obvious as to be trivial, but I mention it here because of the curious fact that one can also find in Helmholtz's work suggestions of what has been called a second, alternative theory of consonance and dissonance<sup>69</sup>—one which could be considered as a possible explanation of that "similarity" or "affinity" between tones sounded successively, which characterizes 'consonance' in CDC-1. I will not go into this alternative theory here, but reserve it's discussion for another paper dealing with the physical correlates of consonance and dissonance in their various forms. The point to be made here is simply that the theory of beats, because it deals only with individual simultaneous aggregates, has nothing to do with CDC-1.

Having eliminated CDC-1 and CDC-4 as possible equivalents of CDC-5, we are left with but two other candidates: CDC-2 and CDC-3. The latter, however, can be disposed of quickly, on the basis of one of its most important characteristics—the designation of the perfect fourth as a dissonance. Helmholtz's theory would find the fourth definitely consonant—only slightly less so than the fifth. In fact, the rank order of common intervals according to their relative consonance or dissonance in CDC-5 is virtually identical to

those associated with CDC-2. Is it possible, then, that CDC-5 is merely a latter-day manifestation of CDC-2?

In several earlier drafts of this book I did in fact interpret the situation in this way—and this, in turn, forced me to conclude that Helmholtz's equation of dissonance with "roughness" (and this with beats) had resulted in a "theory-induced distortion" of CDC-2. But certain implications of the beat theory—especially as these have been developed in more recent psychoacoustic work—now persuade me that the two forms of the CDC are not the same, and that CDC-5 must be considered a separate and relatively independent form. These implications of the theory are (1) that, in CDC-5, consonance and dissonance (or "smoothness" and "roughness") must depend on pitch register, timbre, and perhaps even dynamic level, and (2) that the terms 'consonance' and 'dissonance' must be applicable not only to dyads and larger simultaneous tone-combinations but to *single tones* as well. In none of these ways is there any clear correspondence between CDC-5 and CDC-2.

The fact that the consonance or dissonance predicted by the beat theory for a given dyad would vary with the absolute frequencies of its tones, rather than simply the interval between them, has been pointed out by many other writers—and generally used as an argument against the validity of Helmholtz's theory. Helmholtz himself was obviously as aware of this relationship as anyone, but evidently did not consider it to be a problem. In more recent extensions or refinements of the beat theory, however, this factor becomes quite explicit (see, for example, Plomp and Levelt (1965),<sup>70</sup> Kameoka and Kuriyagawa (1969),<sup>71</sup> or Hutchinson and Knopoff (1978)<sup>72</sup>).

The relationship between consonance and dissonance in CDC-5 and *timbre*, on the other hand, is mentioned frequently by Helmholtz, since it is an obvious and unavoidable consequence of the beat theory. The consonance or dissonance of a given dyad or larger aggregate—even in a given register—is highly dependent on the overtone structure (i.e. the distribution of relative amplitudes among the harmonic partials) of each compound tone in the aggregate, and therefore (since steady-state timbre is primarily determined by this amplitude distribution, or "spectral envelope") on the specific timbre of each tone. Helmholtz devotes some seven pages of his book to this relationship, from which the following passage is of particular interest for our purposes:

The *clarinet* is distinguished from all other orchestral wind instruments by having no evenly numbered partial tones. To this circumstance must be due many remarkable deviations in the effect of its chords from those of other instruments...when a clarinet is played in combination with a violin or oboe, the majority of consonances will have a perceptibly different effect according as the clarinet takes the upper or the lower note of the chord. Thus the major Third d' f # will sound better when the clarinet takes d' and the oboe f #, so that the 5th partial of the clarinet coincides with the 4th of the oboe. The 3rd and 4th and the 5th and 6th partials (i.e. the oboe's 3rd and 5th, against the clarinet's 4th and 6th), which are so disturbing in the major Third cannot here be heard, because the 4th and 6th partials do not exist on the clarinet. But if the oboe takes d' and the clarinet

f #, the coincident 4th partial will be absent, and the disturbing 3rd and 5th present. For the same reason it follows that the Fourth and minor Third will sound better when the clarinet takes the upper tone.<sup>73</sup>

Now the question as to which of these two arrangements sounds "better" than the other obviously depends on what I have called "aesthetic attitudes" toward consonance and dissonance, and it is possible to cite musical examples—especially from the 20th-century literature—in which the same acoustical considerations (and perhaps, therefore, the same form of the CDC) may well have determined the composer's decisions regarding instrumentation, even though the aesthetic attitudes have been reversed. Thus, for example, the wonderfully searing dissonance (in the sense of CDC-5) created by the piccolo and E clarinet at rehearsal number 1 (measure 16 in the revised edition)<sup>74</sup> near the beginning of the second movement of Varese's *Octandre* would have been far less effective (assuming, as we may, that a strong dissonance is what Varese wanted here) if the parts had been arranged in the more "normal" way, with the piccolo above the clarinet, since the latter has very little if any energy in its second partial (i.e. at the octave) for the production of beats with the high F, whereas *most* of the energy in the piccolo's tone is probably concentrated precisely in that second partial.

There is some disagreement in the psychoacoustical literature as to whether auditory roughness should depend on absolute amplitude or intensity. No such dependence was ever suggested by Helmholtz (although it might be inferred from his analogy between auditory roughness and the effect of "scratching on the nerves of touch"—i.e. it would not be surprising if "roughness" varied with the absolute intensity of the stimulus in both cases). Such a relationship does emerge, however, in the recent work of Kameoka and Kuriyagawa, in which the effects of mutual interference between every pair of partials in a simultaneous aggregate are incorporated into a measure of "dissonance intensity" which, as the authors point out, has the dimension of *power*, and is thus proportional to the squares of the amplitudes involved.<sup>75</sup> There can be no disagreement, however, that any roughness caused by beats would have to depend on the *relative* amplitudes of two or more mutually interfering partials, and since the spectral envelopes of most musical instruments vary with changes of overall dynamic level, there must be at least an *indirect* relationship between this parameter and consonance and dissonance in CDC-5.

One might object that—in CDC-2 (i.e. during the early polyphonic period during which CDC-2 was the prevailing form of the CDC)—the practical ranges in all three of these parameters were so narrow (restricted as they were to medium registers, vocal timbres, and moderate dynamic levels) that there could have been no opportunity to *discover* any such dependency on them of consonance and dissonance, even if it existed. This argument is a cogent one, and seems to be unanswerable at present. I believe, however, that answers will be forthcoming when the problem of consonance and dissonance is approached from another direction—psychoacoustically, rather than historically. If physical correlates can be found for both CDC-2 and CDC-5, and these correlates are themselves clearly distinguishable, then we may be justified in maintaining the distinction between CDC-2 and CDC-5—even if no certain

basis for that distinction could be drawn from historical considerations alone.

There is, however, another distinctive implication of the beat theory which has no precedent in CDC-2, and that is that consonance/dissonance values must be ascribed to *single tones* as well as to dyads and larger aggregates—although not, of course, in a way that has anything to do with CDC-4. When Helmholtz says:

...compound tones with many high upper partials are cutting, jarring [N.B.], or braying.../whereas/...simple tones, or compound tones which have only a few of the lower upper partials...must produce perfectly continuous sensations in the ear.<sup>76</sup>

he is using some of the same adjectives elsewhere used in the definition of 'consonance' and 'dissonance'; the implication is clear here that "compound tones with many high upper partials" are *dissonant*, and simple tones are *consonant*. It would seem that there is some confusion here—or rather, an *assimilation*—between consonance and dissonance, on the one hand, and on the other, *timbre*, and this does not correspond to the uses of 'consonance' or 'dissonance' by any major theorist before Helmholtz. But more recent studies of auditory roughness go even farther, ascribing variations in roughness (with register) even to *simple tones*, with no upper partials at all,<sup>77</sup> and Kameoka and Kuriyagawa, in defining what they call an "absolute zero" level of dissonance, say:

The absolute zero is reached only when both *external and internal noises* are absolutely nil, and the sound pressure is also zero...it is impossible for us to experience the tone /i.e. a single, sinusoidal tone/ with absolute zero dissonance.<sup>78</sup>

Thus, in effect, the only "perfect consonance" would be total silence, and this—as John Cage has reminded us so often<sup>79</sup>—is unattainable (as long as we are alive).

All of these distinguishing characteristics of CDC-5 have been noted by other writers—usually as evidence against Helmholtz's beat theory as a valid explanation of what those writers took to be the "real meaning" of 'consonance' and 'dissonance'. Thus, for example, Norman Cazden has written:

The beat theory appears not to be sustained on the grounds that in its terms, dissonance would arise in the hearing of single tones...and that changes of spacing, timbre, or register would affect consonance and dissonance response. These conditions do not correspond to the normal musical understanding of that response, which is what the beat theory is designed to explain.<sup>80</sup>

But just what is that "normal musical understanding?" For Cazden, it is evidently some form of what I have called CDC-4—a purely "functional" conception of consonance and dissonance—and we have seen that this is only one of several forms of the CDC which have been considered "normal" at one

time or another in the history of western music. Certainly it is not "what the beat theory is designed to explain," although Helmholtz himself was not very clear on this point.

CDC-5 was not "invented" by Helmholtz, of course. It is conceivable that it was always present, in some degree, as a component in earlier forms of the CDC (excluding CDC-1), and merely obscured by other, momentarily stronger components. But it seems to have developed gradually during the first half of the 19th century, as a result of (or in parallel with) several of the stylistic and other innovations characteristic of that period. Its emergence as a dominant component may have only become possible after the appearance of new factors—new aspects of the musical experience—that were unique to this first half of the 19th century. Several such factors suggest themselves immediately: the increasingly dramatic rhetoric of Beethoven, and the radical experiments of Berlioz, had created a new discipline—"orchestration"—in which the specific characteristics of each instrument acquired a new importance in the compositional process; the development of the modern "piano-forte," improvements in certain instrumental mechanisms, the invention of new instruments, and the rapid growth in the sheer size of the orchestra—all these had resulted in a considerable extension of *range* in several parameters (pitch register, timbre, dynamics—precisely those parameters that are of such importance in CDC-5); in addition, with the increasingly chromatic character of the harmonic language, some of the expressive and formal harmonic devices available to the 18th-century composer were undermined by assimilation or "absorption" into the ongoing texture, harmony became less and less effective as a means of formal articulation, and some of the functions of formal articulation formerly carried by harmony alone now had to be taken over by other factors, including dynamic and timbral or textural contrasts, etc.

It was in this milieu that a new conception of consonance and dissonance was eventually articulated—not by a composer (since the major composers of this period were not as inclined toward theoretical speculation as their predecessors of earlier centuries had been), nor even by a music theorist (perhaps because the traditional disciplines of counterpoint and harmony had by then become so totally infused with CDC-3 and CDC-4, respectively), but by a scientist—and one of the very highest calibre—Hermann Helmholtz. Unfortunately, however—for the clarity of the ensuing debate—Helmholtz did not imagine that his assumptions regarding the very nature of consonance and dissonance constituted a new form of the CDC. The theory which he proposed to explain this new conception of consonance and dissonance is presented to the world with all the weight of scientific authority behind it—and rightly so—as when he says:

...I do not hesitate to assert that the preceding investigations, founded upon a more exact analysis of the sensations of tone, and upon purely scientific, as distinct from aesthetic principles, exhibit the true and sufficient cause of consonance and dissonance in music.<sup>81</sup>

and it never seems to have occurred to him that there might be more than one meaning of each of the terms 'consonance' and 'dissonance'. But neither has

such a possibility been considered by the many critics of Helmholtz's theory, and the division into two opposing "camps" thus initiated has continued to this day, with most musician-theorists insisting on a "functional" definition of these terms (i.e. some form of CDC-4), and the scientist-theorists interpreting them in the sense of CDC-5.

Yet—as musicians—I don't think we can quite discount this form of the CDC. It is probably the prevailing conception implicit in the *colloquial* uses of 'consonance' and 'dissonance', and we have not been altogether innocent of such colloquial usages ourselves. In addition, the terms, used in this sense, do describe a very real aspect of the sonorous quality of the sounds we produce and hear—and for the composer, certain aspects of Helmholtz's theory (or its more recent extensions) are quite valuable as tools in the process of orchestration—as the example given earlier from Varèse's *Octandre* should suggest—or, more generally (as in the field of electronic music), in the manipulation and control of timbre, texture, and "sonority."

## Section VI

### Summary and Conclusions: Toward a New Terminology

In an effort to unravel the tangled knot of confusion that currently exists regarding the meanings of 'consonance' and 'dissonance', I have traced the historical development of the consonance/dissonance concept from Pythagoras and Aristoxenus through Rameau and Helmholtz. It has been shown that five different conceptions of consonance and dissonance emerged in the course of that development, and that (with the possible exception of the last one, CDC-5) each of these was closely related to musical practice for an extended period during which it was the prevailing form of the CDC. And yet—since in most cases an earlier form of the CDC was carried over into the following period, and continued to exist along with the newly emergent form—each has survived, in one manifestation or another, to the present.

In the earliest form of the CDC—which I have called CDC-1—the terms 'consonance' and 'dissonance' had an essentially *melodic* connotation, referring to a sense of affinity or *relatedness* between the pitches forming an interval. The consonances were those intervals which were *directly tunable*: the perfect fourth, fifth, octave, and the octave-compounds of these. All other intervals were considered dissonant. The fact that such consonant intervals involved simple integer ratios between string-length was an essential element in the Pythagorean tradition, but even Aristoxenus—in spite of his anti-Pythagorean stance regarding the relevance of such ratios to musical perception—held the same melodic conception of consonance and dissonance, and classified the same intervals as consonant. Although the terms 'consonance' and 'dissonance' are seldom used in this way today, the aspect of musical perception involved in this earliest form of the CDC survives in the contemporary musical vocabulary as (for example) "relations between tones."

With the advent of polyphony in about the 9th century, a new conception of consonance and dissonance emerged—CDC-2—which had to do with an aspect of the *sonorous character* of simultaneous dyads. In its earliest manifestations, this new form of the CDC was only barely distinguishable from its predecessor, because in the earliest forms of polyphony only the consonances of CDC-1 were used to form simultaneous aggregates. With the increasing melodic independence of the added voice or voices in the 10th, 11th, and 12th centuries, however, the category of consonances was gradually expanded to include thirds and (by the same process of expansion, though not until sometime later) sixths. In addition, finer distinctions began to be made with respect to this new dimension of musical perception, leading to more elaborate systems of interval-classification in the 13th century. John of Garland, for example, distinguished six degrees of consonance and dissonance, rank-ordering the intervals along a continuum which ranged from "perfect consonances" at one end (the unison and octave) to "perfect dissonances" at the other (the minor

second, major seventh, and tritone), with varying shades of “intermediate” and “imperfect” consonances and dissonances in between (see Figure 1, Section I). The definitions of these terms given by the major theorists of this period (including Franco of Cologne and Jacobus of Liège, as well as John of Garland) suggest that ‘consonance’ meant something similar to the concept of “fusion” advocated by the 19th-century theorist Carl Stumpf—i.e. the degree to which a simultaneous dyad sounded *like a single tone*. Although the theorists of this period were all strictly Pythagorean in viewpoint, their rank-orderings of intervals did not simply follow the order that would be derived from a consideration of the complexity of their Pythagorean ratios. This suggests that these theorists were carefully listening to the sounds of these dyads, and basing their classification systems on perceived qualities rather than theoretical doctrine.

New developments in polyphonic practice in the later 13th and early 14th centuries—including what came to be called “the art of counterpoint”—eventually led to a new system of interval-classification, and a new conception of consonance and dissonance which I have called CDC-3. This form of the CDC seems to have been shaped by two factors: (1) a tendency to reduce the number of distinctly labelled categories to a smaller set which would have an *operational correspondence* to the rules of counterpoint, and (2) the emergence of a *new criterion* for the evaluation of consonance and dissonance. As a result of the first of these factors, the five or six perceptually distinct categories in CDC-2 were reduced to three operationally distinct categories: “perfect consonances” (octave and fifth), “imperfect consonances” (thirds and sixths), and “dissonances” (all others, including the perfect fourth). Although in most other respects the new classification system looks simply like a reduced version of those in the 13th century, the change in status of the fourth cannot be explained in this way, and thus the second factor listed above is invoked—the emergence of a new criterion, involving another aspect of the sonorous character of simultaneous dyads. Among several hypotheses which might be advanced to account for the peculiar status of the fourth in CDC-3, the most likely one would involve the perceptual effect of an upper voice in a two-part texture on the melodic and/or textual *clarity* of the lower voice.

CDC-3 remained the prevailing conception of consonance and dissonance even after the new “rationalization” of thirds and sixths as consonances in Zarlino’s *senario*, the emergence of the triadic concept, and the profound stylistic innovations of the *seconda pratica* in the late 16th and early 17th centuries. But in the new notation and descriptive language of 17th-century figured-bass practice an ambiguity developed whereby “a consonance” or “a dissonance” might refer not only to the dyad formed with the bass by the note figured, but to that note itself. In the writings of Rameau, beginning with the *Treatise on Harmony of 1722*, what had been merely a kind of verbal shorthand in the language of figured-bass treatises was reinterpreted in a way which became what I call the *dissonant-note concept*. This was central to a new conception of consonance and dissonance—CDC-4. In this form of the CDC, any note which is related to the harmonic root of an aggregate as prime, third, or fifth—i.e. any note which is a triadic component—is a consonance (or consonant note), while any note which is not thus related to the harmonic root is a dissonance (or dissonant note). Because the consonant or dissonant status

of a note depends on the identity of the harmonic root of the chord in which it occurs, any ambiguity regarding that root affects the status of every other note in the chord, and such ambiguities can only be resolved by a consideration of context and function. Since the property associated with consonance or dissonance in CDC-4 can no longer be simply some aspect of “sonorous quality” (or “character”), it is assumed to be its *obligation to resolve* (in the case of a dissonance) or the lack of any such obligation (in the case of a consonance). And since “obligation” later becomes “tendency,” *motion* is implied. Thus, in CDC-4, consonance and dissonance no longer have any direct or necessary connection to “sonorous qualities,” and definitions are possible in which such qualities are not involved at all—‘consonance’ and ‘dissonance’ can become purely “functional.” With certain modifications instituted by Kirnberger, CDC-4 has become an essential element in 20th-century formulations of the theory of “common practice” harmony.

Finally, in response to the increasingly chromatic character of the harmonic language during the first half of the 19th century, to the radical extensions of pitch-registral, dynamic, and timbral ranges made possible by the growth of the orchestra, and to the increasing use of contrast in these parameters to serve some of the functions of formal articulation previously carried (in the diatonic/triadic tonal system) by *harmony alone*, a new conception of consonance and dissonance emerged, which I have designed CDC-5. In this form of the CDC—first clearly articulated by Helmholtz in 1862—the dissonance of a dyad or larger simultaneous aggregate is defined as equivalent to its “roughness,” and this turns out to be dependent on pitch register, timbre, and intensity, as well as on its constituent intervals. In addition, it becomes appropriate to ascribe consonance/dissonance values to single tones (although *not* in the sense of CDC-4)—as well as to dyads and larger tone-combinations. Although the relevance of CDC-5 to musical practice has frequently been questioned (especially by music theorists concerned with more “functional” definitions of ‘consonance’ and ‘dissonance’), it is the form of the CDC implicit in most psychoacoustical studies that have been done since the work of Helmholtz, and is probably the basis for the prevailing colloquial uses of the terms (even by many musicians).

Thus, in the course of the two-and-a-half millennia since Pythagoras, the entitive referents for ‘consonance’ and ‘dissonance’ have changed from *melodic intervals* (in CDC-1), to *simultaneous dyads* (in CDC-2 and CDC-3—eventually extended to larger aggregates as well), and then to *individual tones* in a chord (in CDC-4), and finally to virtually *any sound* (in CDC-5). The qualitative referents have changed correspondingly from *relations between pitches*, through aspects of the *sonorous character* of dyads (and then larger aggregates), to the *tendencies toward motion* of individual tones, and then again to still another aspect of the *sonorous character* of simultaneous aggregates. The implicit definition of ‘consonance’ has gone through a sequence of transformations from *directly tunable* (in CDC-1), to *sounding like a single tone* (in CDC-2), to a condition of *melodic/textual clarity* in the lower voice of a contrapuntal texture (in CDC-3), to *stability as a triadic component* (in CDC-4), and finally to *smoothness* (in CDC-5)—with ‘dissonance’ meaning the opposite of each of these. In only one instance did the semantic transformation involved in the transition from one form of the CDC to another result in a clear replacement

of one set of meanings by another, and that was with the shift from an essentially “horizontal” orientation in CDC-1 to a “vertical” one in CDC-2. In all other cases the process was cumulative, with the newly emergent set of meanings simply being added to the earlier ones, and thus contributing to the current confusion. This brief summary of the general evolution of the CDC is represented schematically in Figure 6. (See Appendix).

With the possible exception of Riemann (and his definitions of ‘consonance’ and ‘dissonance’ can easily be treated as a variant or extension of CDC-4), no theorist of the 19th century appears to have held a conception of consonance and dissonance that differed in its basic assumptions from one of the five forms of the CDC described above. Nor does any really new form seem to be expressed in the writings of the most prominent theorists of the first half of the 20th century, although other aspects of harmonic theory were developed by them in important new directions. The references to consonance and dissonance by Schoenberg, Schenker, Hindemith, *et al.* can usually be identified as manifestations of one or more of these earlier forms of the CDC, although the distinctions I have made between these forms are not generally made explicit in their writings.

One obvious reason for the current semantic confusion and disagreement regarding the meaning of ‘consonance’ and ‘dissonance’ is simply that these same two words are continually being used to mean different (though perhaps equally important) things—often without any apparent awareness or explicit acknowledgment that this is the case—and the obvious remedy for this would be to *qualify* these terms in some way which would clarify which of these several meanings is intended. Another source of confusion and disagreement has been the inclination on the part of some recent theorists to *redefine* ‘consonance’ and ‘dissonance’ in ways which are completely different from every semantic or lexical tradition preceding the 20th century, or to insist on the *exclusive* use of these terms in a purely functional sense. For example, Cogan and Escot (in *Sonic Design*, 1976) have proposed what they call a “consonance-dissonance system,” which they define as follows:

...a consonance-dissonance system...is a *context* that creates a hierarchy of intervals...some of which are *predominant* (consonances), and some *subordinate* (dissonances). In such a system the dissonances are handled specially so that they do not intrude upon the basic sonority that is established, predominantly, by the consonances.<sup>82</sup>

The conception of consonance and dissonance implied here appears to be essentially *statistical*, and a distinction between “predominant” and “subordinate” intervals would of course be very useful as a means of describing the characteristic sonority of a piece—or of a whole style-period. But the use of such statistical measures as criteria for *defining* ‘consonance’ and ‘dissonance’ clearly puts the cart before the horse. Consonant aggregates do indeed “predominate” in Western music from the 9th through the 19th centuries, but it is not this fact in itself that makes them “consonant.” On the contrary, they were used “predominantly” *because they were considered to be consonant*—according to one or more criteria having little if anything to do

with statistical frequency—and consonant textures were clearly preferred by composers of that period. On the other hand, many 20th-century composers evidently prefer *dissonant* textures, but in accordance with such a “consonance-dissonance system,” the ubiquitous seconds, sevenths, and ninths in the music of Schoenberg, Webern, Ruggles, or Varèse would have to be called “consonances,” and the less frequent octaves, fifths, etc., “dissonances.” This is certainly not the way these composers would have described the various aggregates in their own music; Schoenberg’s “emancipation of the dissonance” was surely never interpreted by any of them as an occasion for the semantic *reversal* of the consonance/dissonance polarity.

To a great extent, of course, the natural evolution of a language inevitably involves some radical semantic transformations, and these will often include what Lewis Rowell has aptly called “semantic casualties.”<sup>83</sup> But in Cogan and Escot’s “consonance-dissonance system” (and even in Riemann’s “extrapolation” of CDC-4) the words *consonance* and *dissonance* have been appropriated to mean something quite different from any of their earlier meanings—and something, incidentally, which could be expressed quite adequately by terms like “predominant” and “subordinate” (or “stability” and “instability” in relation to a tonic, in Riemann’s case). These terms are invariably invoked in order to explain what is *meant* by ‘consonance’ and ‘dissonance’ in these new formulations anyway, so there is really no need to use these older words at all.

One of the most outspoken advocates of an exclusively “functional” definition of ‘consonance’ and ‘dissonance’ has been Norman Cazden, who recommends the term *euphony* for this non-functional form of the CDC—or rather, for *all* of the various non-functional aspects of “sonorous quality” which might be invoked in the description of tone-combinations.<sup>84</sup> Similarly, Richard Bobbitt has insisted that:

...studies in music theory should no longer use the terms “consonance” and “dissonance” when describing the quality of isolated, non-functional intervals...<sup>85</sup>

for which he would simply substitute the term “intervallic quality.” But neither Cazden nor Bobbitt seems to be aware that the use of the words ‘consonance’ and ‘dissonance’ in a “non-functional” sense is supported by a long and venerable historical tradition—beginning in the 9th century, remaining essentially unchallenged after the transition from CDC-2 to CDC-3 in the 14th century, and surviving in some manifestations right through to the present day. Although I am not the first to have noted some of the distinctions between the several forms of the CDC which have been discussed in the book, I would seem to be alone in suggesting that it is not these “non-functional” senses of consonance and dissonance which are in need of a new terminology, but rather the purely functional or contextual senses which have arisen only since the 17th century.

That a new, more precise terminology is urgently needed, however, is beyond dispute, and the distinctions that have been made here on the basis of a historical analysis might be useful in developing such a terminology. The inelegant acro-

nyms used in this book to designate the different conceptions of consonance and dissonance ("CDC-n") were chosen deliberately for their neutral and essentially uninformative character, and I never expected or intended that they should be adopted for use outside of this present context. But the distinctions between the qualitative referents in the various forms of the CDC—and between their implicit definitions of 'consonance' and 'dissonance'—suggest one possible approach to the solution of this problem of terminology. That is, qualifying words or phrases might be used which reflect the different meanings more clearly, and I will suggest the following: for CDC-1, *monophonic or melodic* consonance and dissonance; for CDC-2, *diaphonic* consonance and dissonance; for CDC-3, *polyphonic or contrapuntal* consonance and dissonance; for CDC-4, *triadic* consonance and dissonance (this form is often called "functional," but this is not altogether accurate either, and might better be reserved for the more *purely* functional conception articulated by Riemann—although his might also be called *tonic* consonance and dissonance, if not simply "stability/instability"), and finally—for CDC-5—*timbral* consonance and dissonance.

Such a use of qualifying terms is one possibility suggested by the results of the historical investigations reported in this book. As a lasting solution to the terminological problem, however, it is not as attractive to me as another, more radical one, which is also made possible by these results. That is—having made these distinctions between basically different conceptions of consonance and dissonance—it has at last become feasible to search for acoustical (or better, psychoacoustical) *correlates* of each of these forms of the CDC. And if such correlates can be found, they might themselves suggest a terminology which is more precise than any that can be derived from historical data alone. The research outlined in this book was originally motivated by a desire to clarify certain questions that arose during just such a search for acoustical correlates of consonance and dissonance. That effort reached an impasse at a certain point, with the realization that the various theoretical disagreements regarding consonance and dissonance were not merely disagreements about their physical (or other) basis, but much deeper ones having to do with the very nature of the perceptual phenomenon signified by the terms themselves. Quite obviously then, any search for "correlates" (whether physical, psychological, or other)—and thus any effort to develop an explanatory *theory* of consonance and dissonance—was doomed to failure almost before it began, since there was no common consensus as to what it was that such a theory would need to "explain."

One of my initial assumptions was that—although many of the important aspects of harmonic practice would not be amenable to a purely acoustical analysis—at least *some* of them might be—and that it was merely a question of isolating these from the plethora of facts and concepts associated with various periods in the history of harmonic practice which could *not* be dealt with acoustically. I am now convinced, however, that *acoustical correlates can be found for each of the five forms of the CDC* which have been identified here. It is beyond the scope of this book, however, to even begin to present the theoretical analysis from which such correlates might be derived, and that analysis will therefore be presented elsewhere.

There are many similarities between what I have called in this book "conceptions of consonance and dissonance" and the concept of "paradigms"

developed by Thomas Kuhn in *The Structure of Scientific Revolutions* (1962).<sup>86</sup> Like each of the major paradigms in the history of science, each form of the CDC provided an effective conceptual framework for musical practice (as for what Kuhn calls "normal science") during some extended historical period—although it could not have answered every question that arose during that period. As Kuhn says:

To be accepted as a paradigm, a theory must seem better than its competitors, but it need not, and in fact never does, explain all the facts with which it can be confronted.<sup>87</sup>

That "normal" activity (whether scientific or musical) may even contain the seeds of a subsequent conceptual "revolution," since:

...research under a paradigm must be a particularly effective way of inducing paradigm change. That is what fundamental novelties of fact and theory do. Produced inadvertently by a game played under one set of rules, their assimilation requires the elaboration of another set.<sup>88</sup>

For a time, however, such novelties or "anomalies" may not give rise to paradigm change, because of a natural and valuable cultural inertia:

In the normal mode of discovery, even resistance to change has a use... By ensuring that the paradigm will not be too easily surrendered, resistance guarantees that scientists will not be lightly distracted and that the anomalies that lead to paradigm change will penetrate existing knowledge to the core. The very fact that a significant scientific novelty so often emerges simultaneously from several laboratories is an index both to the strongly traditional nature of normal science and to the completeness with which that traditional pursuit prepares the way for its own change.<sup>89</sup>

Partly because of the inevitable emergence of such novelties or anomalies—and perhaps partly because of the elusive nature of "reality" itself—a period of "crisis" eventually occurs:

...when...the profession can no longer evade anomalies that subvert the existing tradition of scientific practice—then begin the extra-ordinary investigations that lead the profession at last to a new set of commitments, a new basis for the practice of science. The extra-ordinary episodes in which that shift of professional commitments occurs are the ones known...as scientific revolutions.<sup>90</sup>

During such periods of crisis and impending revolution many candidates for a new paradigm may be proposed—and many may possess some measure of viability, since:

Philosophers of science have repeatedly demonstrated that more than one theoretical construction can always be placed upon a given collection of data. History of science indicates

that, particularly in the early developmental stages of a new paradigm, it is not even very difficult to invent such alternates. But that invention of alternates is just what scientists seldom undertake except during the pre-paradigm stage of their science's development and at very special occasions during its subsequent evolution. So long as the tools a paradigm supplies continue to prove capable of solving the problems it defines, science moves fastest and penetrates most deeply through confident employment of those tools. The reason is clear. As in manufacture so in science—retooling is an extravagance to be reserved for the occasion that demands it. The significance of crises is the indication they provide that an occasion for retooling has arrived.<sup>91</sup>

What finally does emerge from such a period of crisis will usually be radically different from its predecessors:

The transition from a paradigm in crisis to a new one from which a new tradition of normal science can emerge is... a reconstruction of the field from new fundamentals, a reconstruction that changes some of the field's most elementary theoretical generalizations as well as many of its paradigm methods and applications. During the transition period there will be a large but never complete overlap between the problems that can be solved by the old and by the new paradigm. But there will also be a decisive difference in the modes of solution. When the transition is complete, the profession will have changed its view of the field, its methods, and its goals.<sup>92</sup>

The parallels between this aspect of the history of science and the emergence of new conceptions of consonance and dissonance in the history of music are remarkable. Equally remarkable is the fact that in both fields there is a tendency toward a distortion of the real history of these changes—a distortion especially noticeable in textbooks, which—as Kuhn says:

...being pedagogic vehicles for the perpetuation of normal science, have to be rewritten...in the aftermath of each scientific revolution, and, once rewritten, they inevitably disguise not only the role but the very existence of the revolutions that produced them... Textbooks thus begin by truncating the scientist's sense of his discipline's history and then proceed to supply a substitute for what they have eliminated... the textbook-derived tradition in which scientists come to sense their participation is one that, in fact, never existed... *Scientists are not, of course, the only group that tends to see its discipline's past developing linearly toward its present vantage.* The temptation to write history backward is both omnipresent and perennial [my emphasis].<sup>93</sup>

Indeed they are not! But the analogies between scientific and music theoretical textbooks are much closer than Kuhn seems to realize, when he says:

In music, the graphic arts, and literature, the practitioner gains his education by exposure to the works of other artists, principally earlier artists. Textbooks...have only a secondary role.<sup>94</sup>

I think this underestimates the extent to which a music student's attitudes toward "the works of...earlier artists" are conditioned by the textbooks which purport to explain the theoretical premises of their music.

If such distortions of history are questionable in science, how much more so they should be in music, where a quest for "truth" has not generally been considered to be the fundamental motivating force. And yet—as the many parallels between the histories of science and music suggest—these two disciplines may have more in common than has been supposed since the demise of the Medieval *quadrivium*. The very fact that it now seems possible to develop a new terminology for 'consonance' and 'dissonance' which is relevant to each of the five historical forms of the CDC—but is based strictly on objective physical or structural characteristics of musical sounds—is persuasive evidence that there has always been an intimate connection between musical perception, practice, and theory—on the one hand, and on the other—what Rameau and the philosophers of the Enlightenment chose to call "nature." One wonders now how it could ever have been thought otherwise. To a far greater extent than has hitherto been recognized, the Western musical enterprise has been characterized by an effort to *understand* musical sounds, not merely to manipulate them—to *comprehend* "nature," as much as to "conquer" her—and thus to *illuminate* the musical experience rather than simply to impose upon it either a willful personal "vision" or a timid imitation of inherited conventions, habits, assumptions, or "assertions." In this enterprise, both composers and theorists have participated, although in different, mutually complementary ways—the former dealing with what might be called the "theatre" of music, as the latter with its theory. A conception of these as indeed mutually complementary aspects of one and the same thing is suggested by the fact that both *theory* and *theatre* derive from the same etymological root—the Greek verb *theasmai*—which was used (I am told) by Homer and Herodotus to mean "to gaze at or behold with wonder."

## NOTES Part Three: Sections IV, V, and VI

1. See p. 22, Section II.
2. See pp. 64 and 66-67, Section III.
3. Jean-Philippe Rameau, *Treatise on Harmony* (1722), translated by Philip Gossett (New York: Dover, 1971), p. xli.
4. *Ibid.*, p. xlii.
5. *Ibid.*, p. 6.
6. *Ibid.*, p. 11.
7. *Ibid.*, p. 317
8. *Ibid.*, pp. 119-20.
9. *Ibid.*, p. 70.
10. *Ibid.*, p. 141.
11. *Ibid.*, pp. 59-60.
12. *Ibid.*, p. 13.
13. B. Glenn Chandler, *Rameau's "Nouveau Système de Musique Théorique": An Annotated Translation with Commentary*, Doct. Diss., Indiana University, 1975.
14. Cecil Powell Grant, *Kirnberger versus Rameau: Toward a New Approach to Comparative Theory*, Doct. Diss., University of Cincinnati, 1976, p. 57, with original French text on pp. 304-5.
15. Sebastien de Brossard, *Dictionnaire de Musique* (1705), reprint: Frits Knuf, Hilversum 1965, pp. 168-9.
16. Rameau, *Treatise...*, *ibid.*, pp. 22-4.
17. René Descartes, *Discours de la méthode...* (1637), available in English translation in Descartes, *Philosophical Essays*, translated by Laurence J. Lafleur (Indianapolis: The Bobbs-Merrill Company, 1961).
18. Roger Lee Briscoe, *Rameau's "Démonstration du Principe de l'Harmonie and "Nouvelles Réflexions de M. Rameau sur sa Démonstration du Principe de l'Harmonie": An Annotated Translation...*, Doct. Diss., Indiana University, 1975, p. 116.
19. *Ibid.*, pp. 114-19.
20. Grant, *op. cit.*, pp. ix-x.
21. Rameau, *ibid.*, p. 112.
22. Deborah Hayes, *Rameau's Theory of Harmonic Generation; An Annotated Translation and Commentary of Génération Harmonique by Jean-Philippe Rameau*, Doct. Diss., Stanford University, 1968, p. 146.
23. Rameau, *ibid.*, pp. 112-13.
24. *Ibid.*, pp. 119-20.
25. Carl Philipp Emanuel Bach, *Essay on the True Art of Playing Keyboard Instruments*, translated and edited by William J. Mitchell (New York: Norton, 1949), pp. 191-2.
26. Jean-Jacques Rousseau, *Dictionnaire de Musique* (1768; reprint, Hildesheim: Georg Olms, 1969), p. 155: "Tout Son qui forme avec un autre, un Accord désagréable à l'oreille, ou mieux, tout Intervalle qui n'est pas consonnant. Or, comme il n'y a point d'autres Consonnances que celle que forment entre eux & avec le fondamental les Sons de l'Accord parfait, il s'ensuit que toute autre Intervalle en [*sic*: est?] une véritable *dissonnance*... On donne le nom de *dissonnance* tantôt à l'Intervalle & tantôt à chacun des deux Sons qui le forment. Mais quoique deux Sons dissonnent entr'eux, le nom de *dissonnance* se donne plus spécialement à celui des deux qui est étranger à l'Accord."
27. Rameau, *ibid.*, p. 152.
28. David W. Beach and Jurgen Thym, "The True Principles for the Practice of Harmony by Johann Philipp Kirnberger: a Translation," *Journal of Music Theory*, Volume

- 23, Number 2 (Fall, 1979), pp. 163-225 (see pp. 169-71).
29. Hugo Riemann, *Dictionary of Music*, translated by J.S. Shedlock (New York: Da Capo, 1970), pp. 192-3.
30. F.T. Arnold, *The Art of Accompaniment from a Thorough-Bass* (London: Oxford University Press, 1931; reprint, New York: Dover, 1965, in two volumes).
31. *Ibid.*, p. 106.
32. *Ibid.*, p. 230.
33. *Ibid.*, p. 199.
34. Knud Jeppesen, *The Style of Palestrina and the Dissonance* (London: Oxford University Press, 1946, and New York: Dover 1970), p. 225.
35. *Ibid.*, p. 163.
36. Rameau, *ibid.*, p. 144.
37. Hayes, *op. cit.*, p. 151.
38. Rameau, *ibid.*, p. 144.
39. Grant, *op. cit.*, p. 142.
40. Francois-Joseph Fétis, *Traité Complet de la Théorie et de la Pratique de l'Harmonie*, ninth edition (Paris: 1867).
41. *Ibid.*, p. 21.
42. Gioseffo Zarlino, *The Art of Counterpoint* (Part Three of *Le Istitutioni harmoniche*, 1558), translated by Guy A. Marco and Claude V. Palisca (New Haven and London: Yale University Press, 1968), p. 34.
43. *Ibid.*, p. 23.
44. *Ibid.*, pp. 172-3.
45. Johann Philipp Kirnberger, *Grundsätze des Generalbasses als erste Linien zur Composition* (1781), as quoted in Grant, *op. cit.*, p. 145.
46. Grant, *op. cit.*, p. 145.
47. *Ibid.*, pp. 144-5.
48. *Ibid.*, pp. 146-7.
49. Rameau, *ibid.*, p. 110.
50. *Ibid.*, p. 111.
51. Manfred Bukofzer, *Music in the Baroque Era* (New York: Norton, 1947), p. 387.
52. Rameau, *ibid.*, pp. 73-5.
53. Chandler, *op. cit.*, pp. 350-52.
54. Hayes, *op. cit.*, pp. 139-40.
55. Beach and Thym, *op. cit.*, p. 176.
56. See above, pp. 59-61 (Section III).
57. Hugo Riemann, "Die Natur der Harmonik" (1882), translated by J.C. Fillmore as "The Nature of Harmony" and added to his *New Lessons in Harmony* (Philadelphia: Theodore Presser, 1887), pp. 29-30.
58. Rameau, *ibid.*, p. 62.
59. Matthew Shirlaw, *The Theory of Harmony* (1917: reprint, New York: Da Capo, 1969), p. xi.
60. *Ibid.*, pp. xv-xvi.
61. Hermann Helmholtz, *On The Sensations of Tone as a Physiological Basis for the Theory of Music* (1862), translated from the edition of 1877 by Alexander J. Ellis (New York: Dover, 1954), p. 194.
62. *Ibid.*, p. 168.
63. *Ibid.*, p. 170.
64. *Ibid.*, p. 226.
65. *Ibid.*, p. 229.
66. *Ibid.*, pp. 346-7.
67. *Ibid.*, p. 347.
68. *Ibid.*

69. Carl Stumpf, "Konsonanz und Dissonanz," *Beiträge zur Akustik und Musikwissenschaft*, 1 (Leipzig: Johann Ambrosius Barth, 1898).
70. R. Plomp and W.J.M. Levelt, "Tonal consonance and critical bandwidth," *Journal of the Acoustical Society of America*, Vol. 38 (1965), pp. 548-60.
71. A. Kameoka and M. Kuriyagawa, "Consonance theory Part I: Consonance of dyads," *Journal of the Acoustical Society of America*, Vol. 45 (1969), pp. 1451-59, and "Consonance theory Part II: Consonance of complex tones and its calculation method," *J. Acoust. Soc. Am.*, Vol. 45 (1969), pp. 1460-69.
72. William Hutchinson and Leon Knopoff, "The Acoustic Component of Western Consonance," *Interface-Journal of New Music Research*, Vol. 7 (1978), pp. 1-29.
73. Helmholtz, *ibid.*, pp. 210-11.
74. Edgard Varèse, *Octandre*, revised and edited by Chou Wen-Chung, 1980, Colfranc Music Publishing Corp., New York.
75. Kameoka and Kuriyagawa, *ibid.*, p. 1461.
76. Helmholtz, *ibid.*, pp. 178-9.
77. Georg von Bekesy, *Experiments in Hearing*, translated and edited by E.G. Wever (New York: McGraw-Hill, 1960), p. 351.
78. Kameoka and Kuriyagawa, *ibid.*, pp. 1455-6.
79. John Cage, *Silence* (Middletown: Wesleyan University Press), p. 8.
80. Norman Cazden, "Sensory Theories of Musical Consonance," *Journal of Aesthetics and Art Criticism* 20 (1962), pp. 301-19.
81. Helmholtz, *ibid.*, p. 227.
82. Robert Cogan and Pozzi Escot, *Sonic Design* (Englewood Cliffs, New Jersey: Prentice-Hall, 1976), p. 128.
83. Lewis Rowell, "Aristoxenus on Rhythm," *Journal of Music Theory*, Vol. 23.1 (Spring, 1979), pp. 63-79 (see especially p. 68).
84. Normann Cazden, "The Definition of Consonance and Dissonance," unpublished, 1975, p. 9.
85. Richard Bobbitt, "The Physical Basis of Intervallic Quality and its Application to the Problem of Dissonance," *Journal of Music Theory*, Vol. 1 (Nov., 1959), pp. 173-235.
86. Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).
87. *Ibid.*, pp. 17-18.
88. *Ibid.*, p. 52.
89. *Ibid.*, p. 65.
90. *Ibid.*, p. 6.
91. *Ibid.*, p. 76.
92. *Ibid.*, pp. 84-85.
93. *Ibid.*, pp. 137-138.
94. *Ibid.*, p. 165.

	1,8	5	4	M3	m3	M6	m6	M2	m7	M7	m2	T
1. <i>Musica (and Scholia) enchiridis</i> (anonymous, 9th-10th c.)	C	C	C	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	D
2. <i>De Harmonica institutione</i> (ca. 900), Hucbald	C	C	C	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
3. <i>Micrologus</i> (1026-28), Guido d'Arezzo	C	C	C	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
4. <i>Ad organum faciendum</i> (anonymous, 11th-12th c.)	C	C	C	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
5. <i>Item de organo</i> (anonymous, 12th c.)	C	C	C	(C)	(C)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
6. <i>Montpellier organum treatise</i> (anonymous, 12th c.)	C	C	C	(C)	(C)	(C)	(C)	(D)	(D)	(D)	(D)	(D)
7. <i>De musica libellus</i> (ca. 1220), Anon. VII (CS I)	pC	mC	mC	iC	iC	(D)	(D)	(D)	(D)	(D)	(D)	(D)
8. <i>De mensurabili musice</i> (ca. 1250) John of Garland	pC	mC	mC	iC	iC	iD	mD	mD	iD	pD	pD	pD
9. <i>Ars cantus mensurabilis</i> (ca. 1260), Franco of Cologne	pC	mC	mC	iC	iC	iD	pD	iD	iD	pD	pD	pD
10. <i>De mensuris et discantu</i> (ca. 1275), Anon. IV (CS I)	pC	mC	mC	iC	iC	D	(D)	(D)	(D)	(D)	(D)	(D)
11. <i>Tractatus de consonantiis musicalibus</i> (late 13th c.), Anon. I (CS I)	pC	mC	mC	iC	iC	iD	pD	iD	iD	pD	pD	pD
12. <i>Tractatus de discantu</i> (late 13th c.), Anon. II (CS I)	pC	mC	mC	iC	iC	iC	D	D	(D)	(D)	D	D
13. <i>De speculatione musicae</i> (ca. 1300), Walter Odington	pC	pC	<sup>i</sup> <sub>p</sub> C	iC	iC	iC	(D)	(D)	(D)	(D)	(D)	(D)
14. <i>Speculum musicae</i> (ca. 1330), Jacobus of Liège	pC	pC	<sup>i</sup> <sub>p</sub> C	<sup>i</sup> <sub>m</sub> C	<sup>i</sup> <sub>m</sub> C	iC	<sup>m</sup> <sub>i</sub> D	<sup>m</sup> <sub>i</sub> C	iC	<sup>m</sup> <sub>i</sub> D	<sup>m</sup> <sub>p</sub> D	<sup>m</sup> <sub>i</sub> D
15. <i>Tractatus de cantu perfecto et imperfecto</i> (14th c.), Henrici de Zelandia (CS III)	pC	mC	D	iC	iC	iC	D	D	D	D	D	D
16. <i>Quatuor principalia musicae</i> (1351), pseudo-Tunstede (CS IV)	pC	pC	iD	iC	iC	iC	iD	iD	pD	pD	pD	pD
17. <i>Ars contrapuncti</i> (late 14th c.), "secundum" Johannes de Muris (CS III)	pC	pC	(D)	iC	iC	iC	(D)	(D)	(D)	(D)	(D)	(D)
18. <i>Ars discantus</i> (late 14th c.), "secundum" Johannes de Muris (CS III)	pC	pC	(D)	iC	iC	iC	iC	(D)	(D)	(D)	(D)	(D)
19. <i>Tractatus de discantu</i> (late 14th c.), Anon. XIII (CS III)	pC	pC	D	iC	iC	iC	iC	D	D	D	D	D
20. <i>Ars contrapunctus</i> (late 14th c.), "secundum" Philippe de Vitry (CS III)	pC	pC	D	iC	iC	iC	iC	D	D	D	D	D
21. <i>Tractatus de contrapuncto</i> (1412), Prosdocimus de Beldemandis	pC	pC	(i)D	iC	iC	iC	iC	D	D	D	D	D
22. <i>Compendium cantus figurati</i> (15th c.), Anon. XII (CS III)	pC	pC	(iC?)	iC	iC	iC	iC	D	D	D	D	(D?)
23. <i>Regilae supra contrapunctum</i> , Johannes Hothby (d. 1487)	pC	pC	(D)	iC	iC	iC	iC	(D)	(D)	(D)	(D)	(D)
24. <i>Liber de arte contrapuncti</i> (1477), Johannes Tinctoris	pC	pC	pC/D	iC	iC	iC	iC	D	D	D	D	D
25. <i>De praeceptis artis musicae...</i> (1480-90), Guilielmus Monachus	pC	pC	(D)	iC	iC	iC	iC	D	D	D	D	D
26. <i>Practica musicae</i> (1496), Franchinus Gafurius	pC	pC	(i)D	iC	iC	iC	iC	D	D	D	D	D
27. <i>Tetrachordum musices</i> (1511), Johannes Cochlaeus	pC	pC	D	iC	iC	iC	iC	D	D	D	D	D
28. <i>Isagoge in musicen</i> (1516), Henry Glarean	pC	pC	(D)	iC	iC	iC	iC	D	D	D	D	D
29. <i>Toscanello in musica</i> (1523), Pietro Aaron	pC	pC	C/D	iC	iC	iC	iC	D	D	D	D	D
30. <i>Le istituzioni harmoniche</i> (1558), Gioseffe Zarlino	pC	pC	pC/D	iC	iC	iC	iC	D	D	D	D	D

Figure 1.

Consonance/dissonance interval-classification systems, 9th-16th centuries.

Legend:

M = major, m = minor, T = tritone (in entry #14 two sizes of tritone are distinguished); CS = as named by Coussemaker in the specified volume of the *Scriptorium...*; C = 'consonance', D = 'dissonance', p = perfect, m = intermediate, i = imperfect (when two of these lower-case letters are used in a single entry, the upper one refers to the first octave-compound of the primary interval classified by the lower one). Entries in parentheses are implied or presumed classifications, not explicitly named as such in the source.

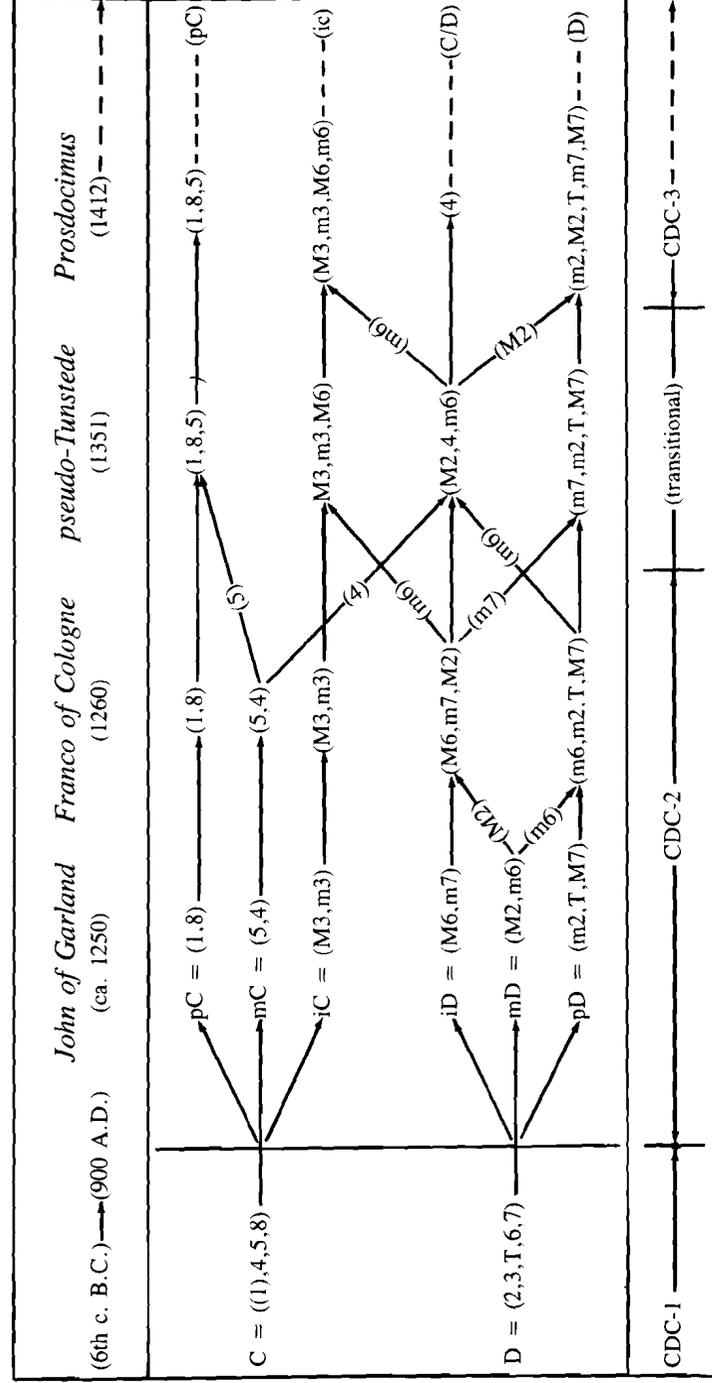


Figure 2. Changes in consonant/dissonant status of each interval.

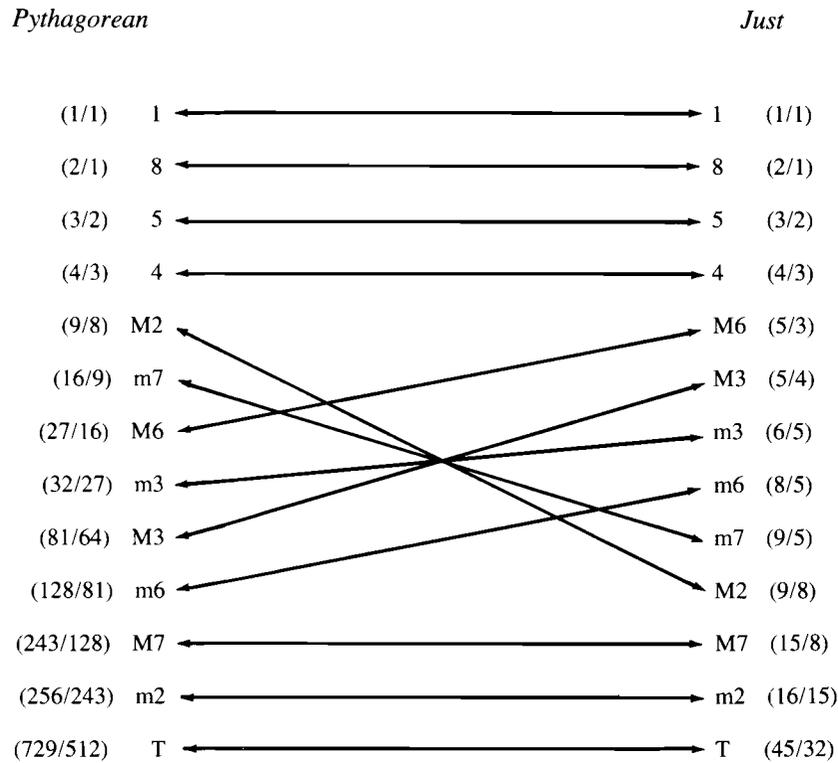


Figure 3.

Rank-orders of intervals according to ratio-complexity in Pythagorean and "Just" tuning systems.

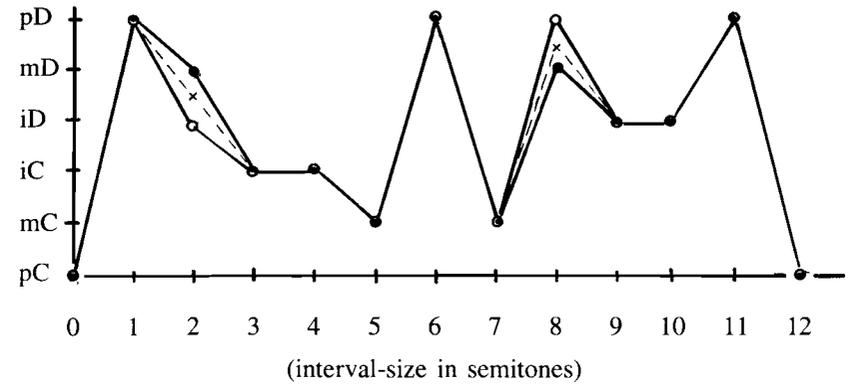


Figure 4a.

13th-century theorists' consonance/dissonance rank-orders of intervals (● = John of Garland's, ○ = Franco of Cologne's, x = 13th-century "average").

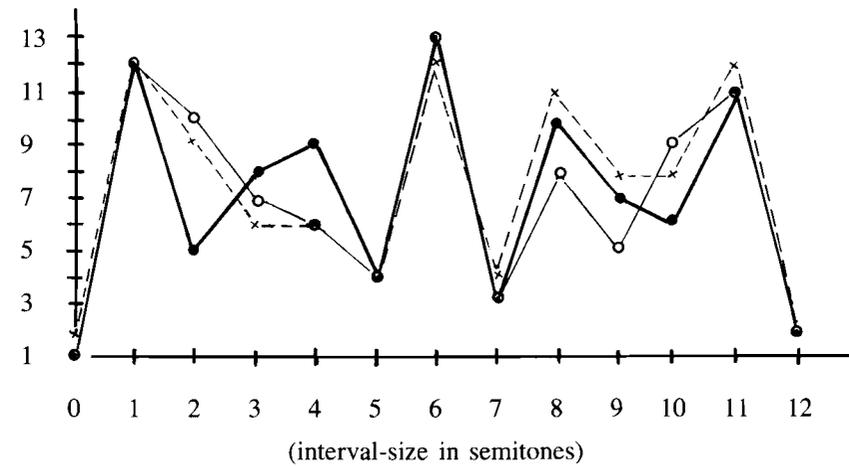


Figure 4b.

Rank-orders of intervals in Pythagorean and "Just" systems compared to 13th-century "average" (● = Pythagorean, ○ = "Just", x = 13th-century "average").



Statistical data on dyad-frequencies in Perotin's *Salvatoris Hodie*, based on the transcription by Ethel Thurston in *The Works of Perotin* (New York: Kalmus, 1970), pp. 100-112. For the figures in the table, the Refrain has only been counted once, even though it would be heard three times in a single performance. Strophe II is in two parts, the Refrain and Strophe I in three (although many dyads are found there too). In the three-part sections, only the lower (or lone) dyad has been considered here.

Interval		all durations and rhythmic positions		at the beginning of a rhythmic group only	
unisons & octaves	1	89	} 14%	66	} 18%
	8	30		22	
seconds	{ m2	21	} 10%	8	} 5%
	{ M2	62		16	
thirds	{ m3	97	} 24%	50	} 22%
	{ M3	101		58	
fourths	4	131	16%	59	12%
tritones	T	8	1%	2	.4%
fifths	5	243	29%	186	38%
sixths	{ m6	12	} 4%	7	} 3%
	{ M6	24		7	
sevenths	{ m7	12	} 3%	5	} 2%
	{ M7	9		3	
other:	M10	1	.1%	1	.2%
Total no. dyads:		840		490	

The preceding data for the Perotin piece may be compared to similar statistics given by Dom Anselm Hughes in *The New Oxford History of Music*, Vol. II (London: Oxford University Press, 1954).

Interval	<i>Luca</i> 603, 11th c. (27 dyads, p. 281)	<i>Chartres</i> 109, 11th c. (241 dyads, p. 284)	Spanish, 12th c. (743 dyads, pp. 298-9)	Anglo-French, 12th c. (2912 dyads, pp. 298-9)	16 two-part conducti, 13th c. (2415 dyads, p. 340)	Perotin: <i>Salvatoris Hodie</i> , (840 dyads, all durations, 490 at beginning of a rhythmic group, in parentheses)
unisons & octaves	41%	32%	38%	37%	27%	14% (18%)
seconds	0%	10%	5%	3%	5%	10% (5%)
thirds	11%	28%	14%	18%	29%	24% (22%)
fourths	30%	20%	13%	9%	13%	16% (12%)
fifths	15%	6%	26%	29%	23%	29% (38%)
sixths	4%	4%	4%	3%	3%	4% (3%)
sevenths	0%	0%	1%	1%	.5%	3% (2%)