

## EDITOR'S INTRODUCTION

WHEN I WAS A young student in California, Lou Harrison suggested that I send one of my first pieces, *Piano Study #5 (for JPR)* to a Dr. Chalmers, who might publish it in his journal *Xenharmonikon*. Flattered and fascinated, I did, and John did, and thus began what is now my twenty year friendship with this polyglot fungus researcher tuning guru science fiction devotee and general everything expert.

Lou first showed me the box of papers, already called *Divisions of the Tetrachord*, in 1975. I liked the idea of this grand, obsessive project, and felt that it needed to be available in a way that was, like John himself, out of the ordinary. When Jody Diamond, Alexis Alrich, and I founded Frog Peak Music (A Composers' Collective) in the early 80s, *Divisions* (along with Tenney's then unpublished *Meta + Hodos*) was in my mind as one of the publishing collective's main reasons for existing, and for calling itself a publisher of "speculative theory."

The publication of this book has been a long and arduous process. Revised manuscripts traveled with me from California to Java and Sumatra (John requested we bring him a sample of the local fungi), and finally to our new home in New Hampshire. The process of writing, editing, and publishing it has taken nearly fifteen years, and spanned various writing technologies. (When John first started using a word processor, and for the first time his many correspondents could actually read his long complicated letters, my wife and I were a bit sad—we had enjoyed reading his completely illegible writing aloud as a kind of sound poetry).

Many people have contributed to the publication of this book, all volunteering their valuable time. David Doty (editor of *I/I*, *The Journal of the Just Imagination Network*) and Daniel J. Wolf (who took over publication of *Xenharmonikon* for several issues in the 1980s) both made a tremendous editorial contribution to style and content. Jarrad Powell, Joel Mandelbaum, David Rothenberg (especially for chapter five) and Jody Diamond made valuable suggestions. Lauren Pratt, who is to copy editing what John Chalmers is to tetrachords, saw countless errors that were not there until she pointed them out. Carter Scholz, the one person I know who can give John Chalmers a run for his money in the area of polymathematics, began as the book's designer, and by virtue of his immeasurable contributions, became its co-editor.

John Chalmers's *Divisions of the Tetrachord* is a fanatic work. It is not a book that everyone will read or understand. It is a book that needs to exist.

LARRY POLANSKY

Lebanon, New Hampshire 1992

## FOREWORD

NEARLY TWENTY YEARS AGO John Chalmers and I had a number of very fruitful conversations. Well acquainted with the work of Harry Partch and also of younger musical theoreticians, Erv Wilson among them, John brought an immense amount of historical and scientific knowledge to our happy meetings. In turn, William Colvig and I brought the substance of professional musical life and the building of musical instruments.

At that time I had rhapsodic plans for a “Mode Room,” possibly for UNESCO, in which would be assembled some great world-book of notated modes, their preferred tunings and both ethnic and geographic provenance, along with such history of them as we might have. I had supposed a roomful of drawers, each holding an octave metallophone of a mode, and somewhere a harp or psaltery of some further octaves’ compass on which one might try out wider musical beauties of the mode under study. I even wrote out such a proposal in Esperanto and distributed it in an international ethnomusicology conference in Tokyo in 1961.

However, a little later Mr. Colvig began to build extremely accurate monochords on which we could study anything at all, and we rushed, in a kind of ecstasy, to try everything at once. Bill and I designed and built a “transfer harp,” wirestrung and with two tuning systems, both gross and fine. Although innocently and quickly designed and built, its form, we discovered, is that of what the Chinese call a “standing harp”— the plate is parallel to the strings. We already owned a Lyon and Healey troubador harp, and, with these and with the addition of one or two other incidental

instruments, a bowed psaltery, drones, and small percussion, Richard Dee and I in one rapturous weekend tuned and recorded improvisations in a fair number of modes from planetary history, especially from the classical civilizations and Islam.

A little later, our friend Larry London, a professional clarinetist with wide intellectual interests and a composer of wide-ranging inquiry, made two improved versions of our original "transfer harp" and he actually revived what literature tells us is the way Irish bards played their own wirestrung harps, stopping off strings as you go. He has composed and plays a beautiful repertory of pieces and suites (each in a single mode) for his harps. I continue to want to hear him in some handsome small marble hall that reminds of Alexandria, Athens, or Rome.

Thus, the "Mode Room," about which I am still asked, turned into anyone's room, with a good monochord and some kind of transfer instrument. But the great book of modes?

Knowing that the tetrachord is the module with which several major civilizations assemble modes, John and I had begun to wonder about how many usable tetrachords there might be. We decided that the ratio  $81/80$  is the "flip-over" point and the limit of musical use, although not of theoretical use. This is the interval that everyone constantly shifts around when singing or playing major and minor diatonic modes, for it is the difference between a major major second ( $9/8$ ) and a minor major second ( $10/9$ ) and the distribution of these two kinds of seconds determines the modal characters. Thus our choice.

John immediately began a program, and began to list results. I think that he used a computer and he soon had quite a list. From his wide reading he also gave attributions as historically documented formations turned up. It was enthralling, and this was indeed the "Great Book"—to my mind the most important work of musical theory since Europe's Renaissance, and probably since the Roman Empire.

But it has taken many years to mature. Not only is John a busy scientist and teacher, but he has wished to bring advanced mathematical thought to the work and enjoys lattice thinking and speculation, often fruitful. He tried a few written introductions which I in turn tried to make intelligible to advanced musicians, who, I thought, might see in his work a marvelous extension of humanist enquiry. Always he found my effort lacking to his needs. He often employed a style of scientese as opaque

to me as his handwriting is illegible. About the latter there is near universal agreement—John himself jestingly joins in this.

In the last very few years all of us have finally had translations into English of Boethius, Ptolemy, and others—all for the first time in our language. For decades before this John worked from the Greek and other languages. This, too, was formidable.

Few studies have stimulated me as has John Chalmers's *Divisions of the Tetrachord*. It is a great work by any standards, and I rejoice.

LOU HARRISON

## PREFACE

THIS BOOK IS WRITTEN to assist the discovery of new musical resources, not to reconstruct the lost musical culture of ancient Greece. I began writing it as an annotated catalog of tetrachords while I was a post-doctoral fellow in the Department of Genetics at the University of California, Berkeley in the early 1970s. Much earlier, I had become fascinated with tuning theory while in high school as a consequence of an unintelligible and incorrect explanation of the 12-tone equal temperament in a music appreciation class. My curiosity was aroused and I went to the library to read more about the subject. There I discovered Helmholtz's *On the Sensations of Tone* with A. J. Ellis's annotations and appendices, which included discussions of non-12-tone equal temperaments and long lists of just intervals and historical scales. Later, the same teacher played the 1936 Havana recording of Julián Carrillo's *Preludio a Colón* to our class, ostensibly to demonstrate the sorry condition of modern music, but I found the piece to be one of almost supernatural beauty, and virtually the only interesting music presented the entire semester.

During the next summer vacation, I made a crude monochord calibrated to 19-tone equal temperament, and later some pan pipes in the 5- and 9-tone equal systems. Otherwise, my interest in microtonal music remained more or less dormant for lack of stimulation until as a sophomore at Stanford I attended its overseas campus in Stuttgart. Music appreciation happened to be one of the required courses and Stockhausen was invited to address the class and play tapes of "elektronische Musik," an art-form totally unknown to me at the time. This experience rekindled my interest in

music theory and upon my return to California, I tried to sign up for courses in experimental music. This proved impossible to do, but I did find Harry Partch's book and a recording of the complete *Oedipus* in the Music Library. Thus I began to study microtonal tuning systems. My roommates were astonished when I drove nails into my desk, strung guitar strings between them, and cut up a broom handle for bridges, but they put up with the resulting sounds more or less gracefully.

During my first year of graduate school in biology at UCSD, I came across the article by Tillman Schafer and Jim Piehl on 19-tone instruments (Schafer and Piehl 1947). Through Schafer, who still lived in San Diego at that time, I met Ivor Darreg and Ervin Wilson. Later Harry Partch joined the UCSD music faculty and taught a class which I audited in 1967-68. About this time also, I began collaborating with Ervin Wilson on the generation of equal temperament and just intonation tables at the UCSD computer center (Chalmers 1974, 1982).

After finishing my Ph.D., I received a post-doctoral fellowship from the National Institutes of Health to do research at the University of Washington in Seattle and from there I moved to Berkeley to the Department of Genetics to continue attempting to study cytoplasmic or non-Mendelian genetics in the mold *Neurospora crassa*. A visit by John Grayson provided an opportunity to drive down to Aptos and meet Lou Harrison. I mentioned to Lou that I had begun a list of tetrachords in an old laboratory notebook and he asked me for a copy.

I photocopied the pages for him and mailed them immediately. Lou urged me to expand my notes into a book about tetrachords, but alas, a number of moves and the demands of a career as both an industrial and academic biologist competed with the task. While working for Merck Sharp & Dohme in New Jersey before moving to Houston in the mid-1970s, I wrote a first and rather tentative draft. I also managed to find the time to edit and publish *Xenharmonikon, An Informal Journal of Experimental Music*, while certain harmonic ideas gestated, but I had to suspend publication in 1979. Happily, it was resurrected in 1986 by Daniel Wolf and I resumed the editorship late in 1989.

In the winter of 1980, I was invited to the Villa Serbelloni on Lake Como by the Rockefeller Foundation to work on the book and I completed another draft there. Finally, through the efforts of Larry Polansky and David Rosenboom, I was able to spend the summer of 1986 at Mills College

working on the manuscript.

It was at Mills also that I discovered that the Macintosh computer has four voices with excellent pitch resolution and is easily programmed in BASIC to produce sound. This unexpected opportunity allowed me to generate and hear a large number of the tetrachords and to test some of my theories, resulting in a significant increase in the size of the Catalog and much of the material in chapter 7.

After returning to Houston to work for a while as a consultant for a biotechnology firm, I moved back to Berkeley in the fall of 1987 so that I could devote the necessary time to completing the book. With time out to do some consulting, learn the HMSL music composition and performing language developed at Mills College, and work as a fungal geneticist once again at the University of California, the book was finally completed.

A few words on the organization of this work are appropriate. The first three chapters are concerned with tetrachordal theory from both classical Graeco-Roman and to a lesser extent medieval Islamic perspectives. The former body of theory and speculation have been discussed *in extenso* by numerous authorities since the revival of scholarship in the West, but the latter has not, as yet, received the attention it deserves from experimentally minded music theorists.

After considerable thought, I have decided to retain the Greek nomenclature, though not the Greek notation. Most importantly, it is used in all the primary and secondary sources I have consulted; readers desiring to do further research on tetrachords will have become familiar with the standard vocabulary as a result of exposure to it in this book. Secondly, the Greek names of the modes differ from the ecclesiastical ones used in most counterpoint classes. To avoid confusion, it is helpful to employ a consistent and unambiguous system, which the Greek terminology provides.

Since many of the musical concepts are novel and the English equivalents of a number of the terms have very different meanings in traditional music theory, the Greek terminology is used throughout. For example, in Greek theory, the adjective *enharmonic* refers to a type of tetrachord containing a step the size of a major third, with or without the well-known microtones. In the liturgical music theory of the Greek Orthodox church, also called Byzantine (Savas 1965; Athanasopoulos 1950), it refers to varieties of diatonic and chromatic tunings, while in traditional European theory, it refers to two differently written notes with the same pitch. Where



modern terms are familiar and unambiguous, and for concepts not part of ancient Greek music theory, I have used the appropriate contemporary technical vocabulary.

Finally, I think the Greek names add a certain mystique or glamour to the subject. I find the sense of historical continuity across two and a half millennia exhilarating—four or more millennia if the Babylonian data on the diatonic scale are correct (Duchesne-Guillemin 1963; Kilmer 1960). Harry Partch must have felt similarly when he began to construct the musical system he called *monophony* (Partch [1949] 1974). Science, including experimental musicology, is a cumulative enterprise; it is essential to know where we have been, as we set out on new paths. Revolutions do not occur *in vacuo*.

The contents of the historical chapters form the background for the new material introduced in chapters 4 through 7. It is in these chapters that nearly all claims for originality and applicability to contemporary composition reside. In particular, chapters 5, 6, and 7 are intended to be of assistance to composers searching for new *materia musica*.

Chapter 8 deals with the heterodox, though fascinating, speculations of Kathleen Schlesinger and some extrapolations from her work. While I do not believe that her theories are descriptive of Greek music at any period, they may serve as the basis for a coherent approach to scale construction independent of their historical validity.

While not intended as a comprehensive treatise on musical scale construction, for which several additional volumes at least as large as this would be required, this work may serve as a layman's guide to the tetrachord and to scales built from tetrachordal modules. With this in mind, a glossary has been provided which consists of technical terms in English pertaining to intonation theory and Greek nomenclature as far as it is relevant to the material and concepts presented in the text. Terms explained in the glossary are italicized at their first appearance in the text.

The catalogs of tetrachords in chapter 9 are both the origin of the book and its justification—the first eight chapters could be considered as an extended commentary on these lists.

## ACKNOWLEDGMENTS

PORTIONS OF CHAPTER 5 and an earlier version of chapter 6 originally appeared in the journal *Xenharmonikon* (Chalmers 1975; 1989). A much shorter draft of the book was written at the Centro Culturale Della Fondazione Rockefeller at Bellagio, Italy while I was a Scholar-in-Residence in 1980. I would like to express my gratitude to Larry Polansky and David Rosenboom for arranging a summer residency for me at Mills College in 1986 to work on the manuscript, and for introducing me to the Macintosh as a word processor and acoustic workstation.

Thanks are also due to Dr. Patricia St. Lawrence for the opportunity to come to Berkeley and work at the Department of Genetics during the academic years 1987–88 and 1988–89.

Parts of this book are based on the unpublished work of Ervin M. Wilson who not only placed his notes at my disposal but also served as a teacher and critic in the early stages of the manuscript. Any errors or omissions in the presentation of his material are solely my fault. The same may be said of David Rothenberg, whose perception theories are a prominent part of chapter 5.

Finally, it was Lou Harrison who suggested that I write a book on tetrachords in the first place and who has patiently awaited its completion.