

Musical Mathematics: On the Art and Science of Acoustic Instruments

Text and Illustrations by Cris Forster

www.chrysalis-foundation.org

Hardcover: 944 pages

Publisher: Chronicle Books, San Francisco

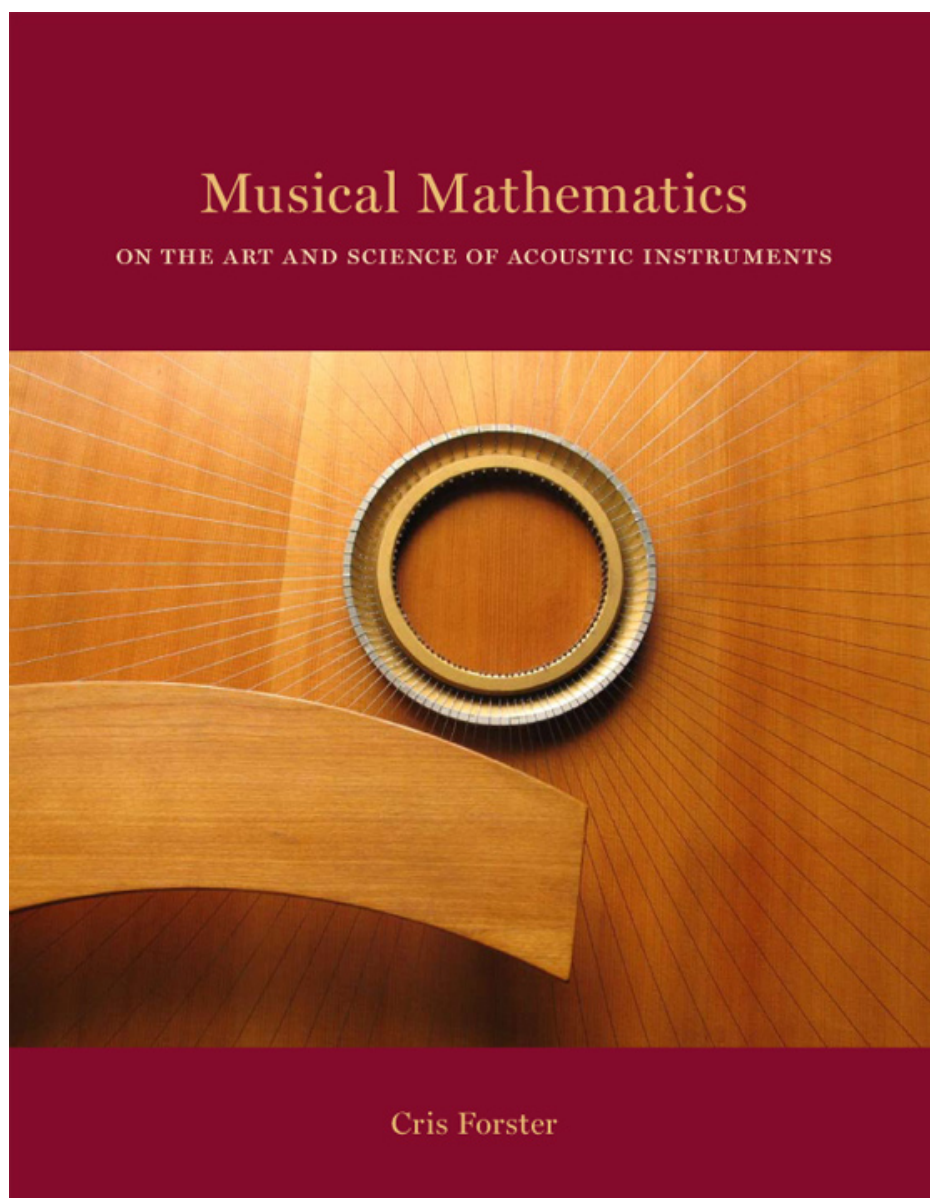
Release Date: July 14, 2010

Language: English

ISBN-10: 0811874079

ISBN-13: 978-0811874076

Thirteen Online Short Reviews





2018


Balinese Gamelan Music on Microtonal Guitar - Chris Charles - Mozilla Firefox


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Balinese Gamelan Music or X +

https://thexvid.com/video/6GoGlj5IyZc/balinese Search

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 **Donny dm** 5 months ago ⁺²
I'm also Indonesian and it really so similar to gamelan that I wonder, how did you study that kind of music where the academic resource is very limited?
The sad thing is the formal studies of microtonal music in Indonesia is almost nonexistent, it will surely be a boost if you could research about that! I loved your channel since 6 yrs ago or so, and finding this only adds my love.

 **Tolgahan Çoğulu** ✓ 5 months ago ⁺¹
Thanks a lot! Cris Forster's Musical Mathematics has a wonderful chapter about Indonesian music. All the best from Istanbul.

2018


Aşık Veysel - Kara Toprak - Microtonal Guitar - Arr. Ricardo Moyano - Mozilla Firefox

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Aşık Veysel - Kara Toprak - X +

https://it-my.com/watchvideo/aşık-veysel-kara-toprak-microtonal-guitar


it-my

 **Riccardo Paolo Bestetti**

Hi! I have some curiosities on microtonal music, I hope you can clarify. - How do you read/write microtonal music? - How do the maths of microtonal music work? I'm a programmer and I was thinking that it would be interesting to create a microtonal music synthesizer. I'm also in the process of building one of those contraptions that play music with floppy disk drives, and it would be awesome to make it play microtonal music as well.

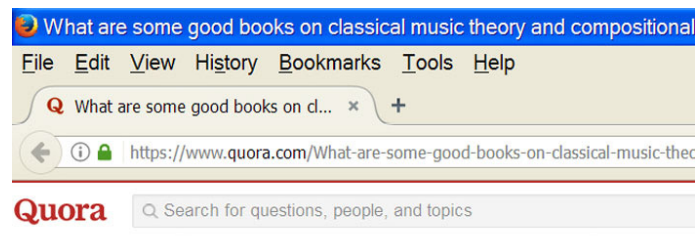
 **Riccardo Paolo Bestetti**

Thank you!

 **Microtonal Guitar - Tolgahan Çoğulu**

*Riccardo Bestetti Hi. When you play makam music of Turkey, the microtonal accidentals have been used. But for other genres like quartertone music, just intonation, every composer has their own notation systems and descriptions. For the 2nd question, Cris Forster's Musical Mathematics book is the answer, such a great book! Touch keys is a very good idea for a synth: it-my.com/watchvideo/video-6fhmlqKHGs8.html

2017



What are some good books on classical music theory and compositional methods?

1 Answer

Timothy Eshing, music teacher
Answered Dec 8 2017

Some great books to start with, in no particular order:

- Arnold Schoenberg: *Theory of Harmony; Structural Functions of Harmony* [probably the best two books on traditional harmony]
- Kostka and Payne: *Tonal Harmony* [a common college textbook]
- Jean-Philippe Rameau: *Treatise on Harmony* [old but still good]
- Levarie and Levy: *Musical Morphology: a discourse and dictionary*
- Igor Stravinsky: *Poetics of Music*
- Paul Fontaine: *Basic Formal Structures in Music*
- Hugo Leichtentritt: *Musical Form*
- Samuel Adler: *The Study of Orchestration*
- Berlioz & Strauss: *Treatise on Instrumentation* [old but still good; Forsyth also recommended]
- Gareth Loy: *Musimathics (vol. 1)* [more about the math; vol. 2 is primarily for people working with digital media]
- Paul Hindemith: *The Craft of Musical Composition (vols. 1 & 2)*
- J. J. Fux: *Gradus ad Parnassum* [old but still really good]
- Ben Johnston: *"Maximum Clarity" and other writings on music*
- Lerdahl & Jackendoff: *A Generative Theory of Tonal Music* [an analytical theory, not a compositional method - but very relevant to the question]

Once you've read those and (hopefully) satiated your desire to learn about classical theory, I'd also recommend reading explications by more modern composers, e.g., Oliver Messiaen's *Technique of My Musical Language*, Harry Partch's *Genesis of a Music*, the collected writings of Brian Ferneyhough, etc.

Also, the anthology *Contemporary Composers On Contemporary Music* is well worth perusing.

If you're interested in learning more about musical mathematics, instrument construction, and/or unconventional tunings (which are discussed in the aforementioned works by Johnston, Partch, etc.), I cannot recommend Cris Forster's *Musical Mathematics* highly enough. It is very thorough, and will be the definitive tome on the subject for years to come.

<https://www.quora.com/What-are-some-good-books-on-classical-music-theory-and-compositional-methods>

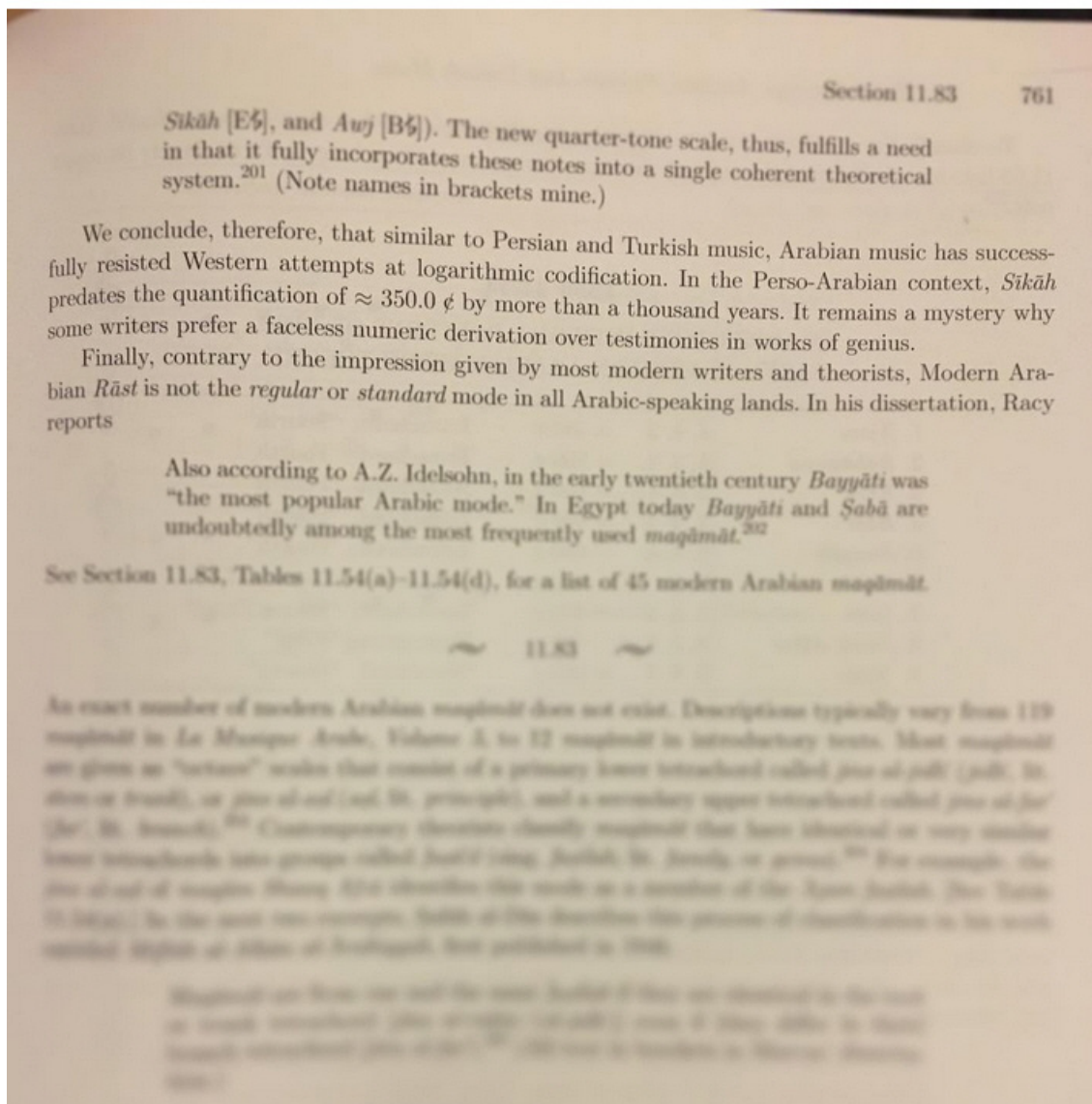
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Instagram Photo by Khyam Alla... x +

<https://web.stagram.com/p/BbNZGI6j6ct>**khyamallami**

Khyam Allami

6d ago



The genius that is Chris Forster, 2010, Musical Mathematics, on the art and science of acoustic instruments

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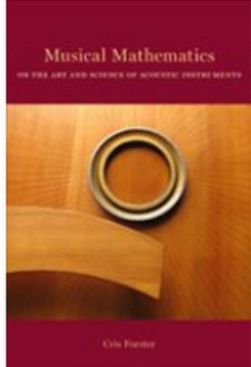
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Petr Pařízek shared a link.
August 5 at 3:19pm

http://chrysalis-foundation.org/Al-Din_and_Ramis.htm



Chrysalis Foundation – Musical Mathematics: Safi Al-Din and Bartolomeo Ramis


The Chrysalis Foundation. We are a public 501(c)3 nonprofit arts and education foundation that supports the work of master builder, writer, and composer Cris Forster, whose original acoustic instruments facilitate new tunings in just intonation.


CHRYSLIS-FOUNDATION.ORG


Like Comment Share


Bill Windes, Michael Vick, Virginia Anderson and 6 others like this.


1 share


 **Stephen Weigel** This is an intense book, and really opened my eyes to where to find some important sources on other musical traditions!
Like · August 6 at 11:41am


 **Frank Zamjatin** I have this, excellent book!
Like · August 6 at 3:59pm

 **Neil Haverstick** Yeah...just the section on Arabic, Turkish, Indonesian, Persian, and Chinese tunings is worth the \$\$\$\$. This is the first time some of those Arabic theorists have been translated into English...great stuff, and man, they were waaayyy ahead of the Europeans in this field...
Like · 4 · August 6 at 6:24pm

 **Stephen Weigel** no kidding! like, centuries ahead
Like · 1 · August 6 at 8:09pm

 **Neil Haverstick** Muslim bashers should take note...
Like · 1 · August 7 at 7:56am


 **Joakim Bang Larsen** Of course a lot of Cris Forsters instruments can be heard here: <https://www.youtube.com/channel/UCMo790HzitixJgYifdalmhw>




Cris Forster

YOUTUBE.COM

Like · 3 · August 7 at 9:04am

 **Kraig Grady** a generous man who helped me more than once on some projects.
Like · 2 · August 7 at 1:11pm

 **Dustin Troyer** I've had the chance to look over Stephen's copy of this book and I would strongly recommend it for every musician interested in xenharmonics. Incredibly comprehensive!
Like · August 7 at 5:54pm

2017

Music as Biology - Dale Purves - Google Books - Mozilla Firefox

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Music as Biology - Dale Purves - ... x +

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sources of local pressure changes at the ear. The central issue going forward is whether this seemingly odd way of defining perception can be used to better understand musical phenomenology.

Conclusion

Sound signals are easy to study in physical terms, which has encouraged a largely physical paradigm in auditory research. However, the inaccessibility of the physical sources of sound signals to auditory animals implies that understanding what we hear and why requires thinking about audition in terms of empirical success over the course of evolution and lifetime learning rather than as a system that measures the physical properties of sound signals. The argument in the chapters that follow is that understanding music and its appeal may be better informed by this biological framework rather than by a framework based on mathematics, physics, or music theory.

Additional Reading

Forster, C. M. L. (2010). *Musical Mathematics*. San Francisco: Chronicle Books.

An encyclopedic account of the math and physics pertinent to music, showing among other things that the descriptions here are grossly simplified versions of more complicated issues.

<https://books.google.com/books?hl=en&lr=&id=YuQZDgAAQBAJ&oi=fnd&pg=PT5&ots=3z1L4OUdF2&sig=3f8VeKLRfTR6qWMJPxV5CQ-Vxks#v=onepage&q&f=false>

2015

Mike's Oud Forums - Powered by XMB - Mozilla Firefox

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jdowning
Oud Junkie
■■■■■

Posts: 3285
Registered: 8-2-2006
Location: Ontario,
Canada
Member Is Offline

Mood: No Mood

posted on 4-22-2015 at 11:40 AM

The fingerboard has been levelled and crowned ready for fitting the frets. I suspect that these surviving fancy versions of the mid sized colascione like the Dean Castle example may have had the courses tuned a fourth apart and fretted like a lute or guitar (i.e. more or less 12 Tone Equal Temperament) - so that they might be played in consort with guitars, mandolins and the like. On the other hand the early full sized version of the colascione played solo by street musicians or to accompany voice or unfretted instruments such as the fiddle may have had a somewhat more complex fretting arrangement based upon Pythagorean scaling.

So the plan for this experimental instrument is to first fret in accordance with Pythagorean scaling just out of curiosity and to test the practicality (or otherwise) of working with some of the close spaced fret arrangements with 18 frets to the octave on a 79 cm vibrating string length instrument. The close spaced frets range from about 5 mm to 10 mm apart.

For convenience I have used the on line Hoffman fret calculator to establish the theoretically correct fret spacing here:

http://www.modoantiquo.com/temperatur/temperatur_en.html

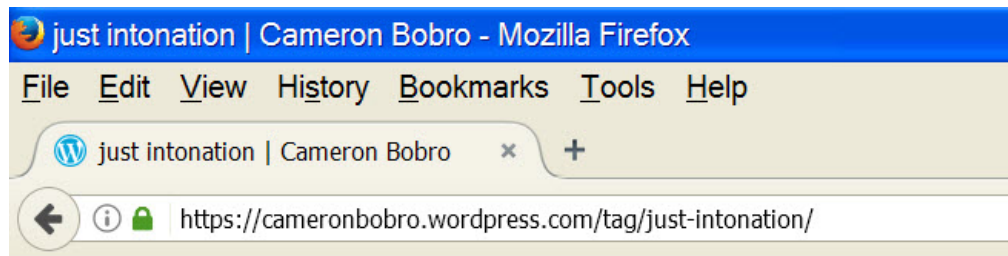
The frets, of course , may be moved around to test other temperaments including the 17 fret to the octave fretting arrangement for the Tunbur described by 10th C philosopher Abu Nasr Al-Farabi - the original text translated and analysed in detail by Chris Forster in his recent encyclopedic, beautifully produced book 'Musical Mathematics - on the art and science of acoustic instruments', 2010, Chronicle Books, San Francisco. Contents and excerpts here:

http://www.chrysalis-foundation.org/musical_mathematics.htm

The Al-Farabi Tunbur had two courses tuned a fourth apart so would require retuning the top string down from d' to c' on this experimental mezzo-colascione. Interestingly the early late 15th C description by Tinctoris of a 'tambura' being played in Naples by Turkish prisoners gives the tuning of a three stringed instrument oddly as "to the octave, fifth and fourth". Presumably Tinctoris meant that the top two strings were tuned either a fourth or a fifth apart?

<http://www.mikeouds.com/messageboard/viewthread.php?tid=15437&page=3#pid106109>

2014



CAMERON BOBRO

ABOUT

music and thoughts on this and that

TAG: JUST INTONATION

May 12, 2014

Okay, a practical introduction to alternative tunings and “microtonality”!

Take a fretless bass or play a guitar with a slide. Any stringed instrument without frets or with a high enough action to use a slide will do. A zither or dulcimer is also ideal.

Up until a couple of hundred years ago, a monochord was standard. You can make one with two nails, a board, a single instrument string and a narrow piece of wood to insert under the string as a movable bridge. You can also build or buy very nice monochords or *canons*. A canon is just like a monochord, but with more strings so that you can work on simultaneous harmonies as well. The great number of different kinds of zithers and dulcimers in the world are descendants of the canon and are essentially still canons. It is not by chance that the middle-eastern hammered zither is called in Turkish the *kanun* and in Arabic qanun.

There is a lovely plan in Cris Forster’s massive tome on tuning and instrument building:

http://www.chrysalis-foundation.org/musical_mathematics.htm

Here at the KIBLA institution we got our copy from Amazon It’s a great book.

<https://cameronbobro.wordpress.com/tag/just-intonation/>

2013

Flutes of the Ancient World by Jerrod Wright on Prezi - Mozilla Firefox


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Flutes of the Ancient World by Je... x +

https://prezi.com/teohe4fufck/flutes-of-the-ancient-world/

Prezi CREATE EXPLORE LEARN & SUPPORT

[Flutes of the Ancient World]



What is a Flute?

A flute, in contrast to those, utilizes neither resonance nor reeds in order to amplify its sound. Instead, flutes are instruments which employ 'edge tones' – i.e., a flute has a fixed edge at one end of the pipe, which a player blows a stream of air across or into. The air vibrates inside the pipe, and those vibrations oscillate to produce

Types of Flutes

Flutes are a member of the woodwind family and have a long history. They are made of various materials, including wood, metal, and plastic. They are played by blowing air across or into a hole in the pipe, which creates vibrations that produce sound.

From What Were Flutes Constructed?

It's likely that the earliest examples of flutes were constructed from

Transverse Flute

Transverse flutes are a type of flute that are played by holding the instrument horizontally. They are made of various materials, including wood, metal, and plastic. They are played by blowing air across or into a hole in the pipe, which creates vibrations that produce sound.

Make a copy Share Embed Like Public & reusable

Flutes of the Ancient World

No description

by Jerrod Wright on 6 December 2013 • 18 [Tweet](#)

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Special thanks to the Chrysalis Foundation

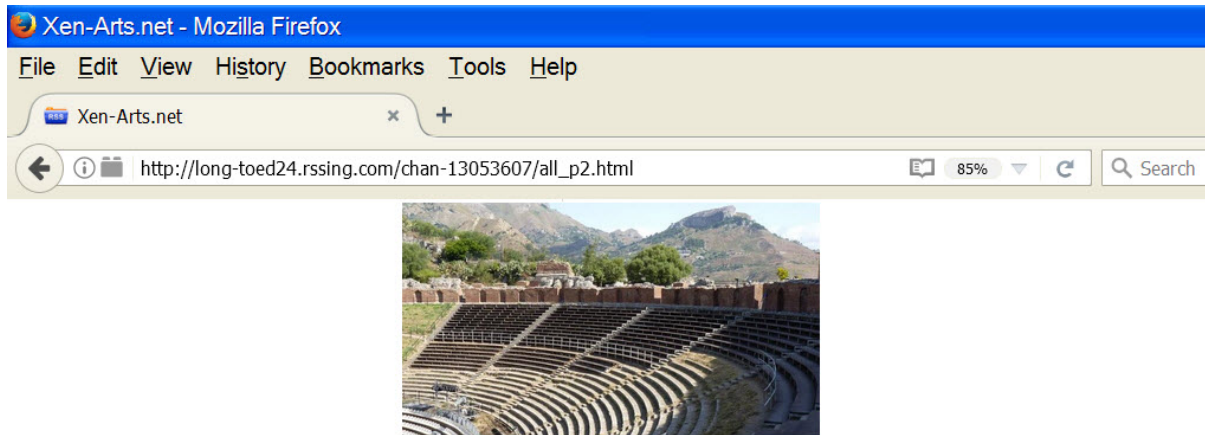
(www.chrysalis-foundation.org)

without which this project would have been hopeless from the beginning.

More presentations by Jerrod Wright

<https://prezi.com/teohe4fufck/flutes-of-the-ancient-world/>

2013



Looks like some interesting ongoing research that includes analysis of speech-rhythms and they even briefly discuss Ptolemy:

Tuning up

"But one shouldn't assume that the Greeks' idea of tuning was identical to ours. Ptolemy in the 2nd century AD provides precise mathematical ratios for numerous different scale-tunings, including one that he says sounds "foreign and homespun".

Timeless: Joan Plowright and John Gielgud preparing a 1959 radio version of a Sophocles play

Dr David Creese of the University of Newcastle has constructed an eight-string "canon" (a zither-like instrument) with movable bridges.

When he plays two versions of the Seikilos tune using Ptolemy's tunings, the second immediately strikes us as exotic, more like Middle Eastern than Western music.

The earliest musical document that survives preserves a few bars of sung music from a play, Orestes by the fifth-century BC tragedian Euripides. It may even be music Euripides himself wrote.

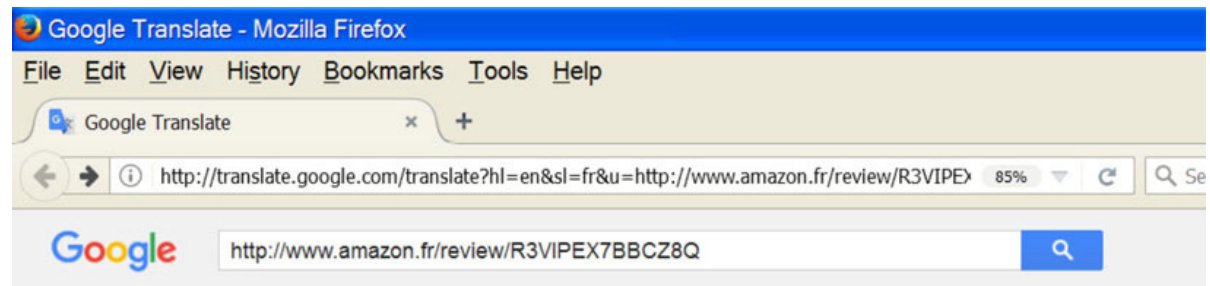
Music of this period used subtle intervals such as quarter-tones. We also find that the melody doesn't conform to the word pitches at all."

As we know though, lots of other deep research into these questions has been done in the past by [John Chalmers](#), author of [Divisions of the Tetrachord](#), [Erv Wilson](#), [Harry Partch](#), and in more recent times, the great work of [Cris Forster of the The Chrysalis Foundation](#), in his wonderful, [Musical Mathematics](#), perhaps one of the most important works on musical instrument intonation and its history published during the 21st century.

One can only hope that this new research discussed in the article will result in instrument reconstructions and microtuning, performance and recorded documentation, so that we can all appreciate these ancient sounds in a new light.

https://long-toed24.rssing.com/chan-13053607/all_p2.html

2012



Translate From: French To: English

In response to [an earlier message](#) of 19 March 2012
Last modification by the author on 19 March 2012

Patrick Le Goux says:

VU +++

Bach did not write a mathematical "way," he had rediscovered the assonances and dissonances which the Pythagoreans had themselves elaborated (in large numbers) through two schools, that of Archytas (Eastern musical filiation) and Philolaos (musical filiation Western) to rehabilitate them in the temperate range which allowed many more combinations. In fact, music is mathematics, but in the old sense of the word. Simple, living and not abstract as it has become. A consonant chord is a ratio of integers that determines the length of a string. $1/2$ of the length of the string: it is the octave; $2/3$ is the fifth; $3/4$ is the fourth; $4/5$ is the third; $5/6$ the minor third ... $8/9$ the major tone; $9/10$ the minor tone ...; $15/16$, the semitone ...; $16/17$ and $17/18$ decreased semitones ...; $24/25$ the $1/4$ of tone; Etc. It is enough to tinker one monochord and graduate it into equal segments to rediscover, in the ear, all these ambitus which Bach used (very intelligently) to elaborate the various musical lines of his counterpoints (by adapting them Astutely to the temperate scale divided into 12 $1/2$ tones strictly equal). For those passionate about it, there is the excellent book by American musicologist Cris Forster "Musical Mathematics" at Chronicle Books, San Francisco. 926 pages. But everything is there. At the present time, it is the only author who has made such a thorough synthesis of musical techniques from antiquity to the present day. A monumental work, bewildering*, in its conciseness and with a biblio that covers everything that has been published, especially from antiquity to the Renaissance. To conclude, making music is necessarily doing without knowing math, otherwise the consonance would be impossible, since it is necessarily mathematical. Which means that the ear, spontaneously recognizing a consonance, spontaneously does math. The genius of Pythagoras is to have found the mathematical relationship (lengths of strings) that governed the notes used until then intuitively, "to the ear". It has disconnected everything and allowed the music to develop, take off. The temperate range has an advantage, it has been to standardize the $1/2$ tones and consequently the tones, strictly equal. Its disadvantage is to have suppressed the nuances between the tones (minor and major) and between the semitones (minor and major) without mentioning the $1/3$ of tones (with a large number of shades) and the same for the $1/4$ tones with almost infinite nuances that have disappeared from our music; It was the price to pay for the flexibility afforded by the temperate scale to the detriment of the shade that made the ladders more rigid.

*Fr. 'ahurissant', En. 'astounding'

2010

Mike's Oud Forums - Powered by XMB - Mozilla Firefox

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Mike's Oud Forums - Powered by XMB

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jdowning
Oud Junkie
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Posts: 3285
Registered:
8-2-2006
Location: Ontario,
Canada
Member Is Offline
Mood: No Mood

posted on 8-11-2010 at 12:41 PM

Musical Mathematics by Chris Forster

After a wait of several months, my pre-publication order of Chris Forster's book "Musical Mathematics" has arrived pretty well on schedule.

This is an impressive work of scholarship - both a valuable source reference and a step by step tutorial leading to a comprehensive understanding of the material presented.

The book itself is a quality production - large format, hard cover, cloth bound (weighing 2.5 Kg - 5.75 lbs) - over 900 pages. The binding (Smyth sewn?) allows the heavy book to conveniently lay flat when open - an essential design feature as the tome is most easily read when supported on a flat surface (not on one's lap when sitting, relaxed, in an arm chair).

Chris Forster is an innovative (microtonal) instrument designer, builder and composer and the content of his book reflects over 12 years of research into worldwide tuning systems and instrument physics - not only related to stringed instrument design but also percussion and wind instrument design.

The mathematics involved appears to fairly basic - not involving complexities like calculus.

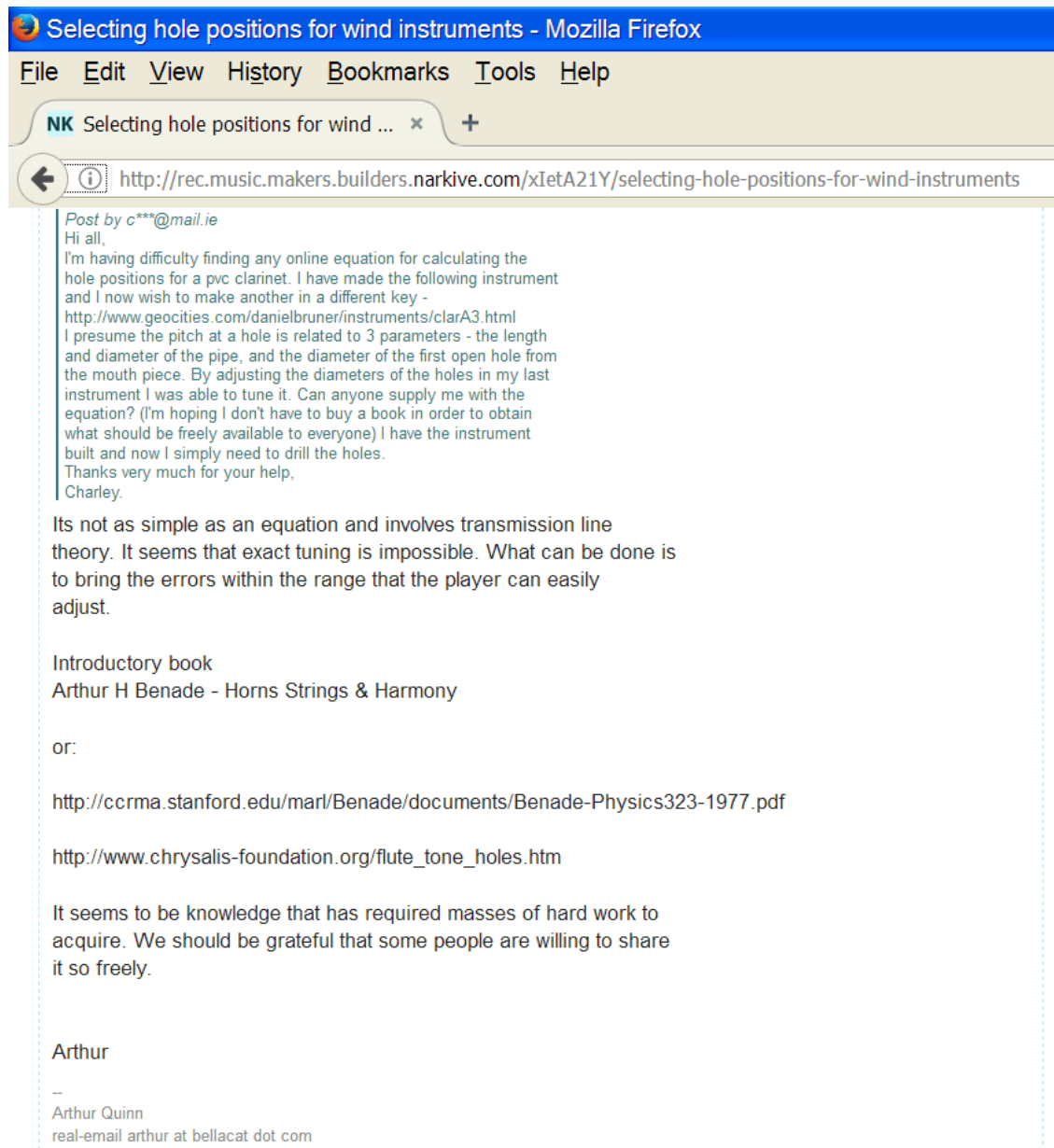
Of particular interest to forum members - who may be interested in the history of the oud and related instruments of the Middle East - is the in depth coverage of historic Arabic, Turkish and Persian tuning systems not to mention other ethnic tuning systems (Chinese, Indian and - yes - Western European).

I am not a book collector but anticipate that this first edition would be a 'good investment' to those that are - increasing in monetary value over the years.

Now to get down to some serious reading!!

<http://www.mikeouds.com/messageboard/viewthread.php?tid=10998#pid75387>

2005



The screenshot shows a Mozilla Firefox browser window. The title bar reads "Selecting hole positions for wind instruments - Mozilla Firefox". The menu bar includes "File", "Edit", "View", "History", "Bookmarks", "Tools", and "Help". The address bar shows the URL "http://rec.music.makers.builders.narkive.com/xIetA21Y/selecting-hole-positions-for-wind-instruments". The page content is a forum post by "c***@mail.ie" titled "Post by c***@mail.ie". The post discusses the difficulty of finding an online equation for calculating hole positions for a PVC clarinet and mentions a link to a website: <http://www.geocities.com/danielbruner/instruments/clarA3.html>. The post also mentions a book by Arthur H Benade, "Horns Strings & Harmony", and provides a link to a PDF document: <http://ccrma.stanford.edu/marl/Benade/documents/Benade-Physics323-1977.pdf>. The post concludes with a link to a website: http://www.chrysalis-foundation.org/flute_tone_holes.htm. The post is signed "Arthur" and "Arthur Quinn" with the email "real-email arthur at bellacat dot com".

Post by c***@mail.ie
Hi all,
I'm having difficulty finding any online equation for calculating the hole positions for a pvc clarinet. I have made the following instrument and I now wish to make another in a different key -
<http://www.geocities.com/danielbruner/instruments/clarA3.html>
I presume the pitch at a hole is related to 3 parameters - the length and diameter of the pipe, and the diameter of the first open hole from the mouth piece. By adjusting the diameters of the holes in my last instrument I was able to tune it. Can anyone supply me with the equation? (I'm hoping I don't have to buy a book in order to obtain what should be freely available to everyone) I have the instrument built and now I simply need to drill the holes.
Thanks very much for your help,
Charley.

Its not as simple as an equation and involves transmission line theory. It seems that exact tuning is impossible. What can be done is to bring the errors within the range that the player can easily adjust.

Introductory book
Arthur H Benade - Horns Strings & Harmony

or:

<http://ccrma.stanford.edu/marl/Benade/documents/Benade-Physics323-1977.pdf>

http://www.chrysalis-foundation.org/flute_tone_holes.htm

It seems to be knowledge that has required masses of hard work to acquire. We should be grateful that some people are willing to share it so freely.

Arthur
—
Arthur Quinn
real-email arthur at bellacat dot com

<http://rec.music.makers.builders.narkive.com/xIetA21Y/selecting-hole-positions-for-wind-instruments>

For more information about

Musical Mathematics: On the Art and Science of Acoustic Instruments

please visit:

https://www.chrysalis-foundation.org/Musical_Mathematics_Pages.htm

<https://www.amazon.com/Musical-Mathematics-Science-Acoustic-Instruments/dp/0811874079>