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I, Joel W Matthys, hereby submit this original work as part of the requirements for the degree of Doctor of Musical Arts in Composition.

It is entitled:
Physica, a Composition for Women's Choir and Live Electronics

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Physica,
a Composition for Women's Choir and Live Electronics

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by

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Abstract

*Physica* is a four movement choral composition for SSAA women's choir and computer. The text is drawn from the writings of two female medieval mystics, Hildegard of Bingen (1098 AD – 1179), and Julian of Norwich (1342 – 1416).

Three excerpts from Hildegard of Bingen's text *Physica* form the core of the first, second, and fourth movements, while excerpts from Norwich's *Revelations of Divine Love* appear in the third movement and juxtaposed against the Bingen text in the first movement.

The work explores the unique way these women have described the natural world, by turns familiar and archaic, whimsical and prophetic. The music pays homage to Renaissance chansons and madrigals, particularly the works of composers Clément Janequin and Carlo Gesualdo, through the use of imitative counterpoint, text painting, and onomatopoetics. The computer part is triggered and synthesized live, with harmonies and textures derived from recordings of the text, and is executed in the software environment Pd-extended using my own version of the RTcmix computer music language embedded as a compiled external. As the piece progresses, the text is increasingly distorted to reveal the harmonies of the piece, and to emphasize the great emotional and intellectual distance between these two medieval women and our modern selves.
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Performance Instructions

For the Conductor

The choir and computer parts are intertwined, and should proceed from one to the next with no pause or silence within a movement.

For the Computer Musician

The first, second, and fourth movements have notated computer cues in the score. Numbered cues should be executed on the downbeat of their respective bars, advanced by pressing the space bar. Computer cues should be dovetailed with the choral sound and will require careful coordination with the conductor; too long a delay may lead to an awkward gap, and too short a delay may sound like an interruption. In general, strive for the effect of a conversation between the live performers and the computer.

The audio gain should be adjusted so the computer is at approximately the same volume as the choir (or slightly less). The choir must be able to hear the electronics without being forced to overexert themselves to compete.

The main Physica Pd patch shows three checkboxes, one for each of the movements. Checking a box opens the performance patch for a specific movement, and unchecking it closes it. Closing a performance patch for an individual movement immediately stops the sound for that movement; be careful not to close a patch before the sound has completely decayed. But you must close the previous movement's patch before opening the next one.
Technical Requirements

Prerequisites

- Computer with Linux or Mac OSX (10.6.8 or later)
- Pd-extended 0.43 or later
- Two channel audio system, plus optional monitor for choir
- Zip archive of Pd patch, available from the composer

Installation

1. Copy the zip archive of *Physica* onto your computer and unzip it. On Mac OSX, this is generally done automatically by double-clicking on the icon. (Linux users are assumed to be familiar with the specific procedures for extracting zip archives.)
2. Download and install Pd-extended 0.43 or later, freely available from http://puredata.info/downloads.
3. Open the extracted *Physica* folder and double-click PHYSICA.pd.
4. If you are using an audio interface, you may adjust the audio settings in the Preferences menu. *Physica* requires a sample rate of 48 kHz.
Hildegard of Bingen – excerpts from *Physica*

*The Nightingale*

Take the gallbladder of a nightingale,

and to add one drop of dew found on clean grass.

Then often anoint the eyelids and lashes around the eye –

and if it touches the eye inside a little, it does no harm –

and the dimness will be marvelously removed from the eye.

*The Mole*

The mole likes to live in rich, muddy soil, and it avoids the poor soil,

casting aside what is bad and useless and remaining in that which is good and salubrious.

And it cannot see, but it has a great internal knowledge,

and smells and understands where to go.

Its flesh is no good for people to eat, because it is nourished by dampness,

nor is it good for any medicine.

*The Unicorn*

The unicorn, seeing a girl from afar, marvels that she has no beard

in spite of having the form of men;

and if there are two or three girls at the same time,
he wonders more and is more readily captured while he feasts his eyes on them.
The girls by which unicorns are caught must be noble, not peasants,
not all grown up, or too little, but in mid-adolescence.
Those are the ones he loves, because they are sweet and kind.

Julian of Norwich – excerpts from *Revelations of Divine Love*  

When I was thirty and a half years old, God sent me a bodily sickness.
I lay three days and three nights,
and on the fourth night, I took all the rites of Holy Church,
for I was not expected to live 'til day.
My sight began to fail, and it was dark as night around me.
Suddenly, all my pain was taken from me,
and I was as healthy as ever in my life.
But I was not fully at ease,
and perhaps I regretted not being delivered of this world.
And there appeared in the palm of my hand
a little thing, the size of a hazelnut,
and it was round as a ball.
I looked upon it and wondered, what could this be?
And I was answered, it is all that is made.
And I wondered how it might endure,
for I thought it might suddenly fall to pieces.

2 Adapted from the Middle English by the composer.
Description of the Computer Part

The computer part was designed to use the frequencies present in the voice recording to reveal the composed harmonies of the piece, while requiring minimal technical knowledge on the part of the computer operator. By relying on prerecorded audio as the basis for the electronic part, the potential for technical problems in rehearsal and performance are greatly reduced, while the real-time processing of the audio allows the choir to be flexible and expressive with tempo and rhythm. Rather than using a fixed-format electronic track with a synchronization aid such as a click track, which introduces the potential for technical problems, a single computer musician following the score advances through preset cues in the score.

The computer part is realized in Pd-extended\(^3\), a branch of Miller Puckette's signal flow programming environment Pure Data, and uses rtcmix\(^4\), an encapsulation of the RTcmix music programming language\(^5\) which I developed for Pure Data based on Dr. Brad Garton's research\(^6\). Pure Data provides a stable, cross-platform environment which can be installed and run with very little technical knowledge and at no cost.

Each movement of *Physica* uses a different technique to manipulate the text of the piece. As the piece progresses, the text is increasingly distorted to reveal the harmonies of the piece, and to emphasize the great emotional and intellectual distance between these two medieval women and our modern selves.

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In the first movement, “The Nightingale,” the score indicates ten cues for the computer musician, triggering birdsong and recorded Julian of Norwich text with very little processing on it. A small amount of FFT-based pitch shifting gives the computer audio a hint of the choir's harmonies.

The second movement, “The Mole,” uses RTcmix’s ELL instrument to apply elliptical band pass filters to the Bingen text. A single filter can be tuned to a specific frequency; by using four filters in parallel, each tuned to a different frequency, I draw harmonies out of the recorded speech. This results in shimmering clouds of harmony which blend with the live choir.

Since the second movement ends with a long computer solo, and the fourth movement begins with a computer solo, I chose to compose the third movement with the computer tacet.

In the fourth movement, the computer loops the spoken recording of Bingen's “The Unicorn” run through five comb filters in parallel. Like the elliptical filters in the second movement, the filters are tuned to produce the harmonies of the piece. A comb filter has a sharp, bright tone which gives the music a kind of metallic quality; this emphasizes the strangeness and distance of the Bingen text, in which she describes the procedure for catching unicorns. This processed audio runs throughout the whole movement, resulting in an indeterminate textual counterpoint with the choir, which is singing the same text in four-part imitative counterpoint. Since it may be difficult for the choir to match pitches with the comb filters, a sustained bass note provides an audible harmonic foundation and counterbalances the predominance of high frequencies. As the movement progresses, the filter feedback settings increase, resulting in a sustained, sitar-like plucked string sound. By the end of the movement, the comb filters have rendered the text completely incomprehensible and abstract.
Physica
for SSAA and computer

Texts by
Hildegard of Bingen
Julian of Norwich

Music by
Joel Matthys
I lay three days and three nights,

When I was thirty and a half years old, God sent me a bodily sickness.

(like an echo)

Light and Lively

I. The Nightingale

Joel W. Matthys

for women's choir and computer

Soprano 1

Soprano 2

Alto 1

Alto 2

Computer

Rehearsal Piano

I lay three days and three nights,
stagger breathing as needed

night in gale, night in gale, catch a night in gale, night in gale,

night in gale, night in gale, night in gale, night in gale, night in gale, night in gale,

Take the gall bladder of a night in gale,
night in gale, night in gale, night in gale,
gale, night in gale, night in gale,

take the gall bladder of a

Night in gale, night in gale, night in gale, night in gale, night in gale,

Night in gale, night in gale, night in gale, and to it add

Night in gale, night in gale, and to it add

\[ \text{Comp} \]
\[ \text{Rhsl} \]
and on the fourth night, I took all the rites of Holy Church, for I was not expected to live 'til day.
Take the gall-bladder of a night in gale, one drop of dew found on clean grass.
in gale, night to night in gale, it in gale, add in gale, add in gale, and of a
take the gall. blad. der of a
night in gale, take the gall.
catch a night in gale, night in gale, night in gale, night in gale,
night in gale, night in gale, night in gale, night in gale, night in
night in gale, and to it add
blad. der of a night in gale, and to it add

S1
S2
A1
A2
Comp
Rhsl
comp
Rhsl
mf
mf
My sight began to fail, and it was dark as night around me.

Then often anoint the eyelids and lashes around the

F
Largo

Then often anoint the eyelids and lashes around the
Suddenly, all my pain was taken from me, and I was as healthy as ever in my life.
In gale, night in gale, night in gale, night in gale, night in gale,

catch a night in gale, night in gale,

marvelously, and the dimness will be marvelously,
But I was not fully at ease, and perhaps I regretted not being delivered of this world.
II. The Mole

Adagio \( \dot{=} 96 \)

Alto 1

Soprano 1

Soprano 2

Ah

Ah

Ah

The mole likes to live in

The mole likes to live in

The mole likes to live in

rich muddy soil,

rich muddy soil,

rich muddy soil,

and it avoids the poor soil,

and it avoids the poor soil,

and it avoids the poor soil,
cast-ling a-side what is bad and use-less,

and remaining in that which is good and sa-lu-bri-ous.

and remaining

and remaining
And it cannot see but it has a great internal knowledge, knowledge,

And it cannot see but it has a great internal knowledge, knowledge,

And it cannot see but it has a great internal knowledge, knowledge, and

And it cannot see but it has a great internal knowledge, knowledge,

smells and understands where to go. ah

knowledge, oh ah

knowledge, oh ah

knowledge, oh ah
Its flesh is no good for people to eat, by dampness, nor is it good for any medicine.

Its flesh is no good for people to eat, because it is nourished by dampness, nor is it good for any medicine.

Its flesh is no good for people to eat, because it is nourished by dampness, nor is it good for any medicine.

Its flesh is no good for people to eat, because it is nourished by dampness, nor is it good for any medicine.
III. The Hazelnut

(computer tacet)

And there appeared in the palm of my hand a little thing, the size of a hazelnut,
And it was round as a ball, and

round as a ball. And there appeared in the

thing, the size of a hazel-nut, and it

peared in the palm of my hand a little thing, the size of a hazel-nut,

it was round as a ball. Hazelnut.

palm of my hand a little thing, the size of a hazel-nut.

was round, it was round as a ball Hazelnut.

round as a ball. Hazelnut.
A little slower

I looked up on it

I looked up on it and wondered,

I looked up on it and wondered,

I looked up on it and wondered,

I looked up on it and wondered,

what could it be, what

what could it be, what

what could it be, what

what could it be, what
It is it might answered, "It is all that is made."

Alto solo: and I wondered how it might endure,
for I thought it might suddenly fall to pieces.
The Unicorn. The unicorn, seeing a girl from afar, marvels that she has no beard, in spite of having the form of men.

And if there are two or three girls at the same time, he marvels more and is more readily captured while he feasts his eyes on them. The girls by which unicorns are caught must be noble, not peasants, not all grown up or too little but in mid-adolescence. Those are the ones he loves, because they are sweet and kind. The unicorn, seeing a girl...
time, time, time, at the same time, are girls, girls, girls, and if there are two or three girls at the same time,
are caught corns, corns, corns, corns
un by which

he wonders more and is readi-ly cap- tured while he feasts his

he wonders more and is more readi-ly cap-tured while

The girls by which un-i-corns are caught

The girls by which un-i-corns, by which un-i-corns,
must be noble, not peasants, not all grown

must be noble, not peasants, not

must be noble, not peasants, not

must not be peasants, not all grown

up, or too little, but in mid-adolescence.

all grown up, but in mid-adolescence.

all grown up, or too little, but in mid-adolescence.

up or too little, but in mid-adolescence.
Those are the ones he loves because they are sweet and kind.

Those are the ones he loves because they are sweet and kind.

Those are the ones he loves because they are sweet and kind.

Those are the ones he loves because they are sweet and kind.