

THE HARMONICS OF MUSIC AND MEANING

A sermon preached by Galen Guengerich
With musical illustrations by Walter Klauss
The Unitarian Church of All Souls, NYC

Unitarian Universalist Congregation of the South Fork
July 17, 2005

Reading: Psalm 19 (from the Hebrew Bible)

The heavens are telling the glory of God;
the firmament proclaims God's handiwork.

Day after day the heavens pour forth speech,
and night after night the firmament displays knowledge.
There is no speech, nor are there words;
their language is not heard;
yet their voice goes out through all the earth,
and their words to the end of the world....

The divine law is perfect, reviving the soul:
the divine testimony is sure, making wise the simple.
The divine statutes are right, giving joy to the heart:
the divine commandments are radiant, giving light to the eyes.
The fear of the divine is pure, enduring for ever:
the judgments of the divine are true and righteous altogether.

More to be desired are they than gold, even than much fine gold:
sweeter also than honey and the drippings of the honeycomb.
Moreover by them is thy servant warned:
and in keeping them there is great reward.

Sermon:

John Brockman is a literary agent who maintains the scientific web site Edge.org. According to *The New York Times*, Brockman poses a question each year to a distinguished roster of authors and other notable public figures. The question for 2004 was "What's your law?" In other words, what bit of wisdom or pattern in nature, either grand or small, have you noticed that could be named after you? Here are a few of the responses. Paul Steinhardt, an astrophysicist at Princeton University, offers Steinhardt's Law: "Good science creates two challenging puzzles for each puzzle it solves." Computer scientist David Gelertner responds with Gelertner's Third Law: "Scientists know all the right answers and none of the right questions." John Barrow, a mathematical physicist,

questions the whole idea of universal laws with Barrow's First Law, which states that "Any universe simple enough to be understood is too simple to produce a mind able to understand it."

My favorite universal law posted on Edge.org was originated by Ernst Poppel, a brain researcher at the University of Munich. Dubbed Poppel's Universal, it asserts that "We take life three seconds at a time." Poppel illustrates his law by pointing out that a handshake lasts about three seconds. So does the preparation for a golf swing, short-term memory, a phrase in spontaneous speech, and the pause when channel surfing for a television program to watch.

Poppel's Universal prompted me to formulate a universal law of my own. Like all such laws, it is based on my observation of the natural world, yet it applies directly to our experience as human beings. I call it Galen's Law of Diminutives, or more informally, The Law of the Small. The law is this: "Small adjustments result in big changes." Allow me to describe how I derived this law, and then I will explain how we can apply it to our lives.

My first inkling of the principle that eventually became The Law of The Small came when I attended a presentation on the human genome project by Shirley Tilghman, a molecular biologist who is President of Princeton University. At one point in her lecture, she projected side-by-side photos of a white mouse and an adult human. How many genes does it take to code for a mouse? The answer, she said, is about 30,000. How many genes to code for a human? Her own guess before the genome project began was 78,000—a typical estimate at the time. How many genes did they discover as they mapped the human genome? The answer is about 30,000—roughly the same number as in a mouse. The astounding aspect of this correspondence is that of the 30,000 genes that code for humans and mice, 99% are broadly similar. Small genetic adjustments result in big changes: The Law of The Small.

While this may be an intriguing discovery, it doesn't seem particularly useful for everyday living. The fact that I'm a lot like a mouse yet completely different seems like comparing and contrasting, say, a sunrise and a tomato. Before we can apply the Law of the Small to life, we need to understand it more clearly. To do so, we turn to Leonard Bernstein and Walter Klauss.

Leonard Bernstein's Norton lectures at Harvard in 1973 described what he called the past and the future of music. In his first lecture, he explained how our Western system of tonal music developed. The eighty-eight notes on a modern piano, for example, are arranged in a series of octaves, each of which is divided into twelve equally-spaced tones. This innovation, known as equal temperament, was developed in the seventeenth century and came into widespread use only in the late eighteenth century. But why twelve tones in an octave, one might ask? Why not fourteen or twenty-two? And why should the notes be equally spaced? After all, some tunes and harmonies are not possible in such an inflexible system.

The ancient Greeks spent a lot of time trying to answer these questions. They did not resolve the issue, but they did establish a way of approaching it. Pythagoras is a key figure in the history of music. He is most famous for his Pythagorean Theorem, which says—as you doubtless recall—that the square of the hypotenuse of a right triangle is equal to the sum of the squares of the two other sides. Pythagoras looked for a formula that he could use to systematize the notes on a musical instrument. He searched for a

proportion in nature that could establish a ratio—a formula—for arranging the sequence of notes. His own proposal proved less than successful, but over the centuries people kept trying to find the harmony of heaven and earth: a basis in nature for tuning the music of humanity.

Over a period of about two thousand years, such a basis was discovered. Today we call it the harmonic series. It is based on a universal phenomenon that occurs when a string is caused to vibrate. If you pluck a string, the entire string vibrates in one long motion, sounding what is called the fundamental tone. At the same time, however, the two halves of the string naturally vibrate in their own right, and so do the thirds, the quarters, the fifths, and so on, creating what are known as overtones. Each of these shorter intervals sounds the note, albeit faintly, that an individual string of that length would make. This means that in nature itself, a single note sets up a harmony of its own. Over time, this harmonic series became the basis of the Western tonal system of harmony.

All of this is much easier to understand if Wally illustrates it musically, which he has generously agreed to do. Let's take our second hymn as an example. If Wally plays only the fundamental tones, the melody sounds like this. [Wally plays melody.] The earliest harmony we know about was developed by the ancient Greeks, who used the fundamental and the first overtone, which sounds when the same string vibrates in two halves. The first overtone is one octave above the fundamental, so what the Greeks called harmony was simply the same note moving in parallel octaves. This happens naturally if male and female voices sing the same tune. It sounds like this. [Wally plays the same tune in parallel octaves.] The earliest recorded attempts at harmony in Western Europe came in the ninth century, when the second overtone was added, which comes from the same string vibrating in three thirds. In our terms, this tone is five notes above the fundamental, and it creates the distinctive medieval harmony that moves in parallel fifths. Imagine yourself in a monastery, and listen. [Wally plays parallel fifths.]

By about the twelfth century, the overtone that we know as the major third began to establish its place in the harmony. This tone, along with the fundamental and the fifth, established what we call the major triad, which was to become the basis of Western harmony. Listen to how the music changes when the major third is added. [Wally plays using triads.] As the Law of the Small suggests, these increasingly small intervals make increasingly big changes in what we hear. They give music its color and complexity, its texture and, ultimately, its power.

The rest of the harmonic story gets a lot more complicated, especially as it relates to our twelve-tone scale and the development of the piano. The undisputed hero of this saga is Johann Sebastian Bach, which is why he is revered above all other composers by those who know music best. But for our purposes, the story is a simple one. It illustrates that nature has given us all the music we know in the vibration of a single string. All the notes are already there. If we listen carefully to the small intervals and faint overtones, the music we can make will be magnificent indeed.

All this talk of notes may lead you to wonder about the lowest note ever detected in the universe. As it happens, the lowest note emanates from the center of the Perseus galaxy, a relatively close neighbor to our Milky Way galaxy. Each sound wave in this note from Perseus is about 35,000 light years long and produces a musical tone that, if we

could hear it, would sound a B-flat that is 57 octaves below middle C. This universe of ours is an awe-inspiring place.

But it is more than just awe-inspiring. It is also a source of revelation. The psalmist proclaims that the natural world is the voice of the divine: “The heavens declare God’s glory, and the firmament proclaims God’s handiwork. The heavens pour forth speech, and the firmament displays knowledge. There is no language, nor are there words; yet their voice goes out through all the earth and their words to the end of the world.” In other words, the Book of Nature reveals the divine. Our experience of the natural world is a direct and reliable source of divine revelation. The Law of the Small is altogether dependable, for it comes to us through the handiwork of the divine.

In practical terms, the Law of the Small means that small adjustments can create large changes in our world and in our lives. More to the point, the path from the life you now have to the life you want may be shorter than you think, just like the genetic path from a mouse to a human, or the harmonic path from a melody to a symphony. For example, the difference between being physically fit and being a couch potato comes down to how we spend less than two percent of our time: whether we exercise several hours a week or do something else. In the same way, the difference between people who are confident and focused rather than reactive and unproductive may come down to spending fifteen minutes each morning thinking about, and writing down, the specific goals they intend to achieve that day. Those fifteen minutes represent one percent of the day’s time, but they can easily make a ten-fold difference in outcome.

Here is one more example. The average high school graduate has a speaking vocabulary of between two and three thousand words. The Law of the Small suggests that the difference between people who are sought after as friends or colleagues and those who are merely tolerated or even avoided comes down to how they use a dozen of their vocabulary words. How frequently and how sincerely do they say the following words? “Please. Thank you. I am sorry. I was wrong. I love you. I need help. That was terrific.” Even if your speaking vocabulary is middling-sized, these twelve decisive words make up less than one-half of one percent of the total. Small adjustments in what we say can create big changes in how we live.

Perhaps, in the spirit of Ernst Poppel’s Universal, The Law of the Small should be renamed The Law of Three: three notes, three words, and three seconds. It is long enough and words enough to say “I love you,” “I am sorry,” or “That was terrific.” It gives time enough to think twice before speaking harshly or to choose to make the extra effort. It provides notes enough to make a tune into a fugue or even a sonata. The key is to pay attention to the small adjustments you can make in your life, the little details, and the diminutive differences. The payoff can be huge.

As the 19th Psalm testifies, the laws that are written in the heavens will revive our souls and give joy to our hearts. Heeding them will give light to our eyes and make us wise. When we who dwell on earth live in harmony with the laws that order the universe, our lives will be fine and sweet indeed—finer than gold and sweeter even than honey.