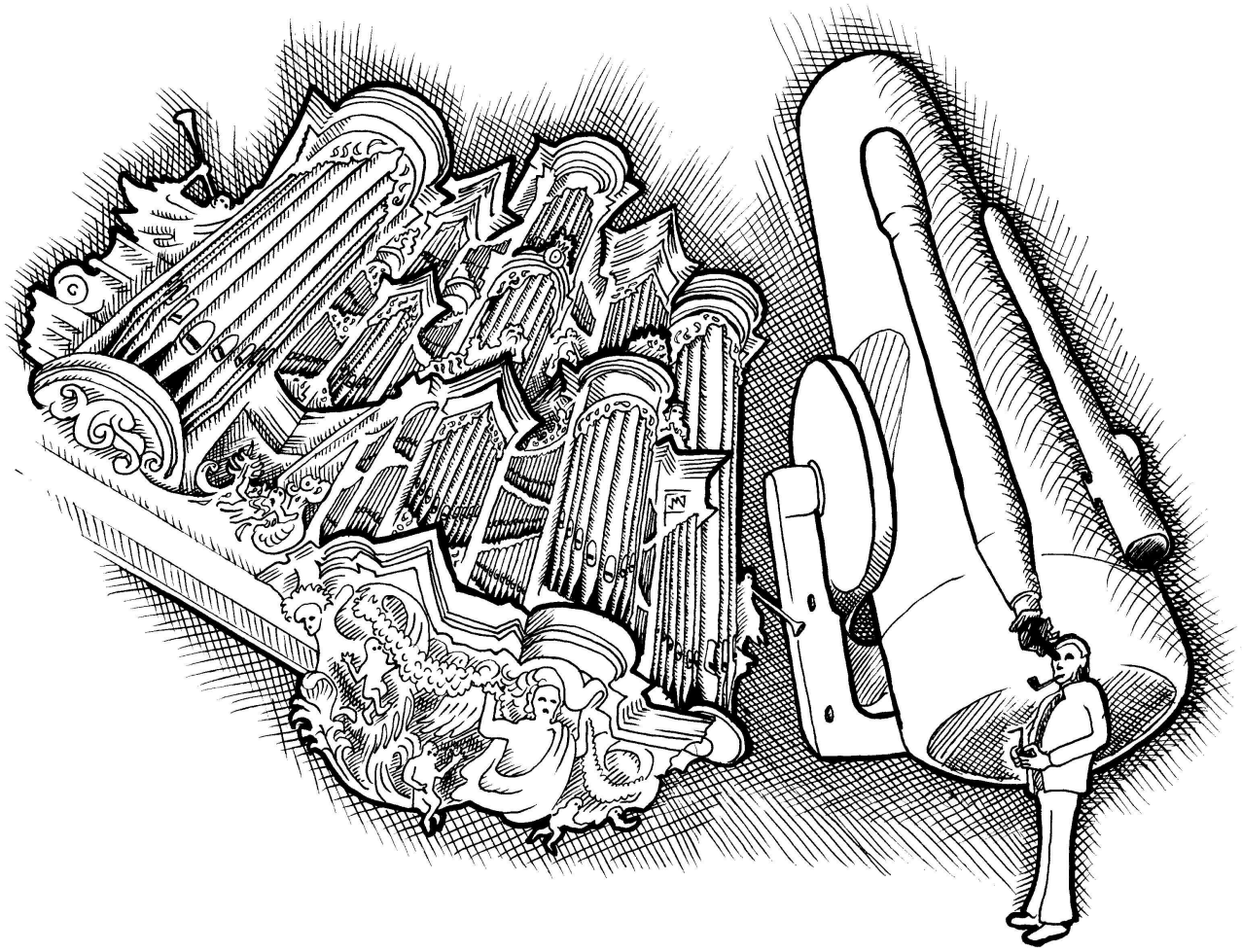


THE QUEST FOR DISCOVERY

The theme of this multimedia concert is the search for the "Lost Chord" as a musical metaphor for the pursuit of a unified "Theory of Everything" in science.

The pipe organ, with its rows of pipes pointed toward heaven, suggests the telescopes and particle accelerators of modern physicists as it tells the story of humanity's quest for physical understanding in a program of just over an hour. The concert takes place in darkness, with footage from the Hubble Space Telescope and other instruments projected continuously on the ceiling and walls of First United Church by John Tutt of the Princess Cinema. Propelled through space and time by the organ music, audience members are encouraged to let their minds drift in contemplation of the human need for truth, beauty and meaning in a vast and baffling universe. Each musical selection is paired with a theme from the story of the quest for unification — the "lost chord" of physics.

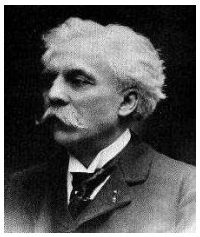
Organist is Jan Overduin (emeritus Professor and Chair of the Organ and Church Music Department at Wilfrid Laurier University), known internationally for his many concert tours, recordings and books, and locally for sold-out performances ranging from the complete organ works of J.S. Bach to the live accompaniment of Fritz Lang's 1930 silent movie masterpiece "Metropolis." Jan plays the newly-installed 44-stop Gabriel Kney mechanical action organ in First United Church, Waterloo.

Note: due to the unusual nature of this concert, audience members are requested to hold their applause until the end of the performance

PROGRAM

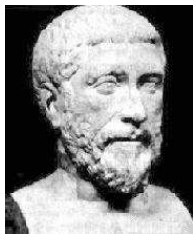
1. Gabriel Fauré, "In Paradisum"

Parallel: The Pre-Scientific Age



Fauré

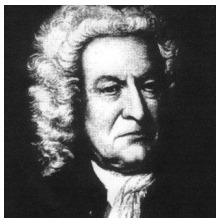
This soft and ethereal prelude (actually a transcription of the final movement of Fauré's "Requiem") represents the "pre-scientific" phase of the quest for unity in natural philosophy, as personified in the figure of Pythagoras, who discovered the intimate relationship between music and mathematics, and who was the first to imagine that a similar relationship might govern the "Harmony of the Spheres." A quote attributed to Pythagoras: "Learn to be silent ... Let your quiet mind listen and absorb."



Pythagoras

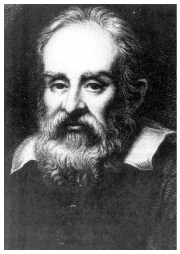
2. Johann Sebastian Bach, "Fantasia in G Minor"

Parallel: Galileo and the Renaissance



Bach

We have chosen Bach and his mastery of musical counterpoint to represent the birth of the scientific method, as epitomized by Galilei Galileo. Henceforth human thought no longer roamed free of all constraints, but entered into a partnership with observation and experiment that would ultimately give humanity unprecedented mastery over its environment. Aristotle had decreed that objects fall according to their weight, and declared the sun to be unblemished: Galileo tried dropping weights and looking at sunspots with a telescope. Bach's impact on music was equally revolutionary. Famed author Neal Stephenson describes his experience of this piece as follows in his best-selling novel "Cryptonomicon" (1999): "... it was as if the math teacher had suddenly played the good part of Bach's Fantasia and Fugue in G Minor on a pipe organ the size of the Spiral Nebula in Andromeda – the part where Uncle Johann dissects the architecture of the Universe in one merciless descending ever-mutating chord, as if his foot is thrusting through skidding layers of garbage until it finally strikes bedrock. In particular, the final steps of the organist's explanation were like a falcon's dive through layer after layer of pretense and illusion, thrilling or sickening or confusing depending on what you were. The heavens were riven open. Lawrence glimpsed choirs of angels ranking off into geometrical infinity ..."



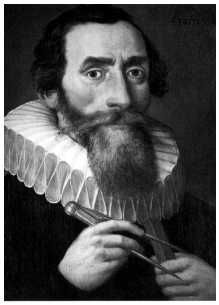
Galileo

3. César Franck, "Deuxième Chorale"

Parallel: Kepler the Mystic

Franck

It would be hard to imagine a more perfect musical match for Johannes Kepler than César Franck, a dreamer who was misunderstood in his own time (not only by critics but by his own wife and sons) and who found his solace in the organ loft, there to play through the night in solitary communion with the cosmos. Kepler, the epitome of the scientific sleepwalker, also ignored the fashions of his day, clinging stubbornly to obscure visions of Platonic perfection that led him by some inexplicable path to the Laws of Planetary Motion. These laws overturned centuries of orthodoxy and opened the way for Newton, who must have had Kepler in mind when he wrote that "If I have seen farther, it is by standing on the shoulders of giants." Franck's three "Chorales" for organ were his last works, composed after a traffic accident that eventually proved fatal. In them he paid homage to his greatest predecessor, to whom he has been compared as follows: "Bach is formidable; he thunders, he has the robust faith of the Middle Ages; his rhythm is colossal; even his gaiety is as alarming as the laughter of a giant. Franck is enamoured of gentleness and consolation, and his music rolls into the soul in long waves, as on the slack of a moonlit tide."

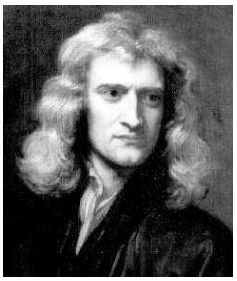


Kepler

4. Olivier Messiaen, "Dieu Parmi Nous"

Parallel: Newton, Motion and Gravitation

Messiaen



Newton

Isaac Newton may have stood on the shoulders of giants, but he went on to lay the foundations for all physics to come, and his laws still describe 99% of human experience today. He unified heavenly laws with those on earth, realizing for example that the force which makes an apple fall to the ground is the same as that which holds the moon to the earth. "God said 'Let there be light'," according to the physicists' account of creation, "and there was Newton." Messiaen is a good match. He is often called the most important composer for the organ after Bach, with one commentator comparing the two as follows: "if Bach constructed a cathedral of sound, then Messiaen's masterpieces are the stained glass, catching, changing and transforming light as it enters the sacred space — illuminating the interior, sending the spirit soaring beyond the confines of stone." Messiaen himself wrote that "stained-glass windows magnify the light, one of God's first creations, but the organ brings to the church something similar to light that yet surpasses it: the music of the Invisible. It is the wondrous overture to the Beyond..." A physicist might hear Newton's Three Laws of Motion and the Law of Gravitation in the four mighty, descending chords that close this piece (the last movement of Messiaen's "Méditations sur La Nativité du Seigneur").

5. Barrie Cabena, "Aurora Borealis"

Parallel: Maxwell and Electromagnetism

Cabena

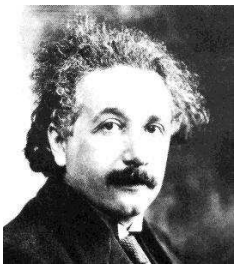
Maxwell

James Clerk Maxwell was the greatest theoretical physicist between Newton and Einstein. Among other achievements he unified the mysterious forces of electricity and magnetism, along the way supplementing the old Greek notion of "particles" with the modern concept of the "field". Perhaps nature's most awe-inspiring demonstration of the electromagnetic field in action, aurorae ("northern lights") are skilfully portrayed here in musical terms by prize-winning Canadian composer Barrie Cabena. A swirling kaleidoscope of flashing lights and colours is conjured up rhythmically, harmonically, and through registration. The mosaic-like structure and free fantasy-style musical painting establish an overall sense of joy and freedom. There are also suggestions of power, especially in the middle part, but the piece ends serenely and quietly, leaving us with an impression of gentle strength. "Aurora borealis" was dedicated to tonight's organist on his 60th birthday in 2003.

6. Richard Felciano, "God of the Expanding Universe"

Parallel: Einstein, Relativity and the Big Bang

Felciano



Einstein

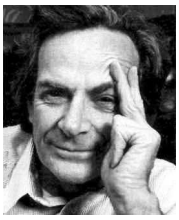
The only physicist to become a household name, Einstein was the greatest unifier of all, and one whose like we may never see again. He rewrote Newton's laws to make them compatible with those of Maxwell, and combined space and time into a single, four-dimensional fabric called "space-time." It was his ambition to unify the geometry of this fabric with matter itself, so that all of physical reality would consist of only one thing, "space-time-matter". He spent the last decades of his life in fruitless pursuit for an even more unified theory that would also incorporate the small world of the quantum. In the fifty years since Einstein's death, no physicist has gone further. The most beautiful of his discoveries was the theory of general relativity, which predicts that the fabric of the cosmos not only bends and twists in the vicinity of matter, but that all of it — space, time and matter — came into existence only two or three earth-ages ago as an infinitesimally small, infinitely dense point,

and has been expanding furiously ever since. (Einstein himself found this hard to swallow, reportedly quipping: "Once you can accept the universe as matter expanding into nothing that is something ... wearing stripes with plaid comes easy.") Modern American composer Richard Felciano has depicted cosmic expansion musically in this pioneering work for organ and tape. The organ part consists of only two notes, one manual and one pedal, held down continuously while stops are manipulated — an evocation of the incomprehensible motor driving the creation event?

7. Philip Glass, Act III conclusion from "Satyagraha"

Parallel: Quantum Physics and the Bomb

Glass

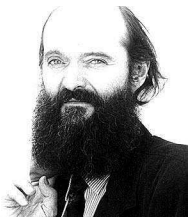


Feynman

Since Einstein, physics seems to have grown too big for any one individual to master, and progress toward unification has increasingly come instead from group efforts. The great joint achievement of theoreticians such as Erwin Schrödinger, Paul Dirac, Richard Feynman, Steven Weinberg and many others in the twentieth century has been the creation of an edifice known as the "Standard Model of Particle Physics" unifying Maxwell's electromagnetism with the quantum theories that govern the very small. This model has been phenomenally successful in the scientific sense. It has also had catastrophic consequences in the human sense. This is the dark side of the Promethean quest for unity and understanding. "Satyagraha," an opera by American composer Philip Glass (famed for such minimalist classics as the opera "Einstein on the Beach" and the "Quatsi" series of movie soundtracks) was not written with physics in mind, but nevertheless evokes both the smallness of the quantum world and its awful power here. To hear them one has to slow one's mind and listen, not just to the surface ripples, but to the larger waves moving beneath them. These "bulk motions" grow steadily more insistent until the middle of the piece, when they are met and countered by heart-rending, higher-pitched wave packets of equal and opposite force. The tension generated by this superposition of contrary motions captures all the weariness and useless suffering of human existence, and it never relents. Rather it is ultimately subsumed in a gradually swelling bass roar from the pedals. The version heard here is an organ transcription by Michael Riesman of the original closing aria from Glass' opera, as sung by the character of Mahatma Gandhi.

8. Arvo Pärt, "Mein Weg hat Gipfel und Wellentäller"

Parallel: Loops, Strings and Higher Dimensions



Pärt

Witten

Physicists today are at a crossroads. Einstein's theory of relativity and the standard model of particle physics both work perfectly in their own domains, but cannot be reconciled with each other. Theorists are trying desperately to combine them, with most occupied by something called "string theory" and a significant minority working on a rival approach known as "loop quantum gravity". The former approach, championed by mathematician Ed Witten and others, begins from particle physics but generalizes the concept of "particles" to that of "strings" vibrating in tiny, unseen extra dimensions. The latter approach, a special focus of many at Waterloo's own Perimeter Institute, begins from relativity but generalizes the concept of "spacetime" in an attempt to reproduce the features of quantum theory. Neither has borne fruit despite decades of trying, and practitioners on both sides are beginning to wonder if physics has reached a dead end. Nevertheless the dream of unification lives on. The situation is perfectly described by this piece from contemporary Estonian composer Arvo Pärt, whose title translates literally as "My Path has Peaks and Valleys" but might also be rendered as "The Road to Unification is Paved with Loops and Strings". Deceptively difficult to play, it consists of three different voices, each one tracing out similar, shimmering patterns of oscillation in midair — but at different speeds. As in many of Pärt's works, one has the simultaneous sense of moving constantly while standing still. The piece is based

on a poem by Edmond Jabes: "My path had its hours of greatness, its blows, its pain. My path has its peak and its valley, its sand and its sky. My road. Yours".

9. Arthur Sullivan, "The Lost Chord"

Parallel: Unknown future thinkers

Sullivan

Where do we go from here? Nobody knows where the human quest for unity and understanding will take us. There is a consensus, however, that we do not lack for calculational wizards. Rather, we require seers like Kepler, Newton, Maxwell and Einstein: dreamers who will follow their own visions, in splendid isolation if need be, and return with the secret of the next scientific revolution. Perhaps one of these people is in the audience? Just in case, the concert concludes with an inspirational Victorian chestnut from Arthur Sullivan (of Gilbert and Sullivan fame) about an organist who accidentally stumbles upon a chord (or two) that lifts the veil and opens the heavens — but only for a fleeting moment:

Person(s) unknown

... It seem'd the harmonious echo
From our discordant life.
It link'd all perplexed meanings
Into one perfect peace.
And trembled away in silence
As if it were loth to cease.
I have sought but to seek it vainly,
That one lost chord divine,
Which came from the soul of the organ,
And entered into mine.
It may be that Death's bright Angel
Will speak in that chord again.
It may be that only in Heaven
I shall hear that grand Amen.

Detail from *The Lost Chord* by Arthur Sullivan
(© Danforth & Co., 1907)

10. Jan Overduin, Improvisation: "the Search for Unification"

"The most beautiful and most profound emotion we can experience is the sensation of the mystical. It is the source of all true science. He to whom this emotion is a stranger, who can no longer wonder and stand rapt in awe, is as good as dead. To know that what is impenetrable to us really exists, manifesting itself as the highest wisdom and the most radiant beauty which our dull faculties can comprehend only in their most primitive forms — this knowledge, this feeling is at the center of true religiousness." – Albert Einstein, as quoted in Lincoln Barnett's *The Universe and Dr. Einstein* (Sloane, New York, 1950)

Jan Overduin

ABOUT THE ORGANIST

A church organist from the age of 12, Jan Overduin made his mark on the Canadian music scene when he won the Healey Willan Prize in 1963. He gained international renown by reaching the finals in the 1970 Festival of Flanders International Organ Competition in Belgium and sharing the main prize at the 1973 St. Alban's International Organ Competition, where he also took the audience prize and reached the finals in improvisation. Jan has given over 15 concert tours in Europe, as well as one in Taiwan, and performs regularly throughout Canada and the U.S.A. He has recorded one album of solo organ works on the historic Riepp organ in Ottobeuren, Germany and eight albums of music for organ and trumpet with Erik Schultz. The author of *Improvisation for Organists* (1998) and *Johann Sebastian Bach's "Die Kunst der Fuge"* (2001), Jan recently retired as Chair of the Organ and Church Music Department of Wilfrid Laurier University. In 2006, he received a "Lifetime Achievement Award" from the Kitchener-Waterloo Arts Awards Foundation.

ABOUT THE PROGRAM

Program notes and cover drawing are by James Overduin, researcher in gravitation and cosmology at Stanford University and author of *Dark Sky, Dark Matter* (2003). The cover image juxtaposes the historic 1738 Christian Müller organ in the Cathedral of Saint Bavo, Haarlem with a photograph of Edwin Hubble, widely credited as the discoverer of cosmic expansion, at the 48-inch Schmidt telescope on Mount Palomar in California.

James Overduin