5

"Quiring to the Young-Eyed Cherubims"

> For man is in receipt of a singular prerogative beyond all other animals, to worship the Existent, but heaven is ever making music, producing in accordance with its celestial motions the perfect harmony.
>
> Philo of Alexandria[1]

If mathematics is inherently theological, it is also mystical. Writing of the contemplative function of symbolic mathematics, Simone Weil says in her *Notebooks*: "Only such a mystical conception of mathematics as this was able to supply the degree of attention necessary in the early stages of geometry."[2]

As we have seen, the "Liberal" Arts are precisely *not* "Servile" Arts that can be justified in terms of their immediate practical purpose. "The

1. Philo 1981, 115.

2. Weil 1956, 2:512. For Weil prayer consists of attention to God and the concentration required to solve (or even attempt) mathematical puzzles is never wasted, since it develops the soul's capacity for the higher attentiveness—not to mention (in the case of those of us who find mathematics difficult) humility!

'liberality' or 'freedom' of the Liberal Arts consists in their not being disposable for purposes, that they do not need to be legitimated by a social function, by being 'work.'"[3] As Josef Pieper argues, the reduction of the liberal to the servile arts would mean the proletarianization of the world. At the heart of any culture worthy of the name is not work but leisure, *schole* in Greek, a word that lies at the root of the English word "school." At its highest, leisure is contemplation. It is an activity that is its own justification, the pure expression of what it is to be human. It is what we do. The "purpose" of the *quadrivium* was to prepare us to contemplate God in an ordered fashion, to take delight in the source of all truth, beauty, and goodness, while the purpose of the *trivium* was to prepare us for the *quadrivium*. The "purpose" of the Liberal Arts is therefore to purify the soul, to discipline the attention so that it becomes capable of devotion to God; that is, prayer.

Having said all of that, we have also seen that there are indeed a myriad practical applications and implications of symbolic mathematics. I suggested in the second chapter that to appreciate the aesthetic and symbolic dimension of numbers and shapes would be the first step in transforming science itself, that most practical of human pursuits. The recovery of a contemplative appreciation of numbers and shapes would also herald a renewal of the arts (painting, sculpture, music, architecture, even film). For it is the contemplative dimension that connects us with the source of inspiration and beauty in the cosmos and our own souls.

Let us now look more closely at the concept of *harmony* that is central in the Pythagorean tradition—illustrating this in terms of music, architecture, ecology, and astronomy.

Good Vibrations

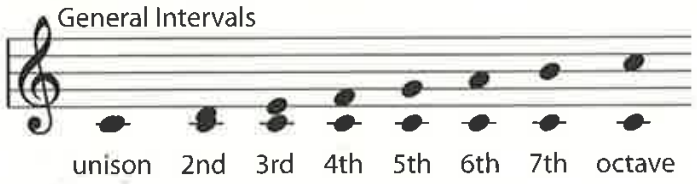
Every material object is capable of vibrating, and furthermore has a "natural frequency" at which it does so, determined by its physical constitution—in fact most have several such frequencies, called "natural harmonics." Thanks to the phenomenon of resonance, whereby the vibration of one thing sets going a vibration in another, the vibration of (say) a guitar string communicates itself to the air and creates a

3. Pieper 1998, 22.

sound wave that we can hear, because the eardrum starts to resonate in sympathy with it.

Harmony—the perceived agreement or "concord" between different frequencies—was first analyzed mathematically by Pythagoras. He noticed that the sounds made by different hammers hitting an anvil depended on the relative weight of the hammer, and that the sounds seemed to fit together in a pleasing way when the respective weights were in certain ratios to each other (so, for example, when one hammer was exactly twice as heavy as another). The lowest note (or pitch) produced by an instrument such as a string or hammer, or a column of air in the case of a wind instrument, is called its fundamental frequency or "first harmonic." The wavelength of this note will be exactly twice the length of the string. By shortening the string, or holding it partway along its length, another harmonic is produced. In fact any string will naturally vibrate first as a unit, and then in halves, thirds, quarters, and fifths—producing a series of "overtones."

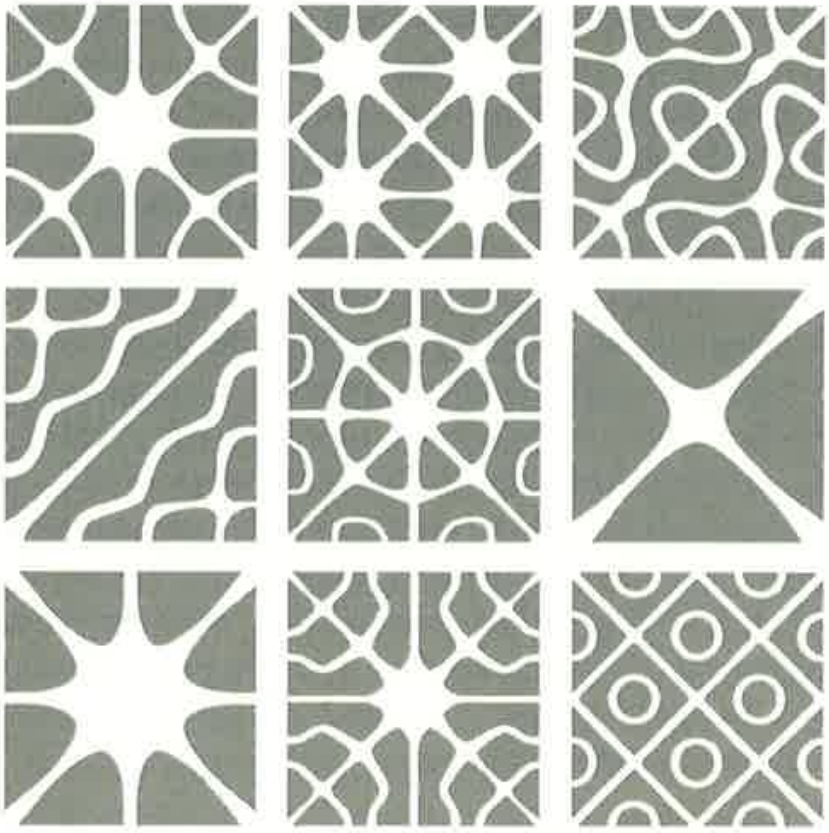
The difference in frequency between one pitch and another is called an "interval," the "octave" being the name given to the interval separating the first and second harmonics (2:1).[4] Within the octave the Western classical tradition recognizes seven intervals in a major scale: "unison," "second," "third," "fourth," etc. up to "seventh," each slightly bigger than the one before:



Notes that are in whole-number ratios to each other sound good together. These ratios can be displayed visually by an instrument called a harmonograph, in which each vibration is conveyed by pendulum to a pen and paper. Harmonic or resonant patterns can also be displayed

4. It is called "octave" because the classical scale was divided into seven notes. By raising the pitch from one note to another you could progress through the scale contained between the first and second harmonics. The eighth step up would commence another octave, just as the eighth day of one week is the first of the next. (Similar principles seem to apply to color, for just as our ear naturally distinguishes seven notes in a scale, our eye tends to distinguish seven colors in a rainbow.)

on a plate covered in sand that is made to vibrate at certain frequencies by being connected to a sound system. Either way, sounds made by notes that harmonize together turn out to be visually, as well as audibly, beautiful:



Chladni patterns produced by sand on a vibrating metal plate.

For the Pythagoreans the whole universe was composed of a single "octave," the interval between 1 and 2, Unity and Diversity, Monad and Dyad. The musical scale was thus nothing less than a model of the cosmos, and could be analyzed mathematically in a way that confirmed our intuitive response to beauty.[5]

5. Platonists following the *Timaeus* expressed this model in the form of the Greek letter *lambda* (Λ). At the top they placed unity, source of all other numbers, with immediately below that the first even and first odd, followed by squares and cubes corresponding to the first, second, and third dimension of space: line, plane, and solid.

1
2 3
4 9
8 27

From the ratios between these seven fundamental integers they could deduce (by taking the arithmetic and harmonic means of the numbers) musical consonances, the music of the heavens, and the harmonies of the soul.

In the twelfth century, at the cathedral of Notre Dame in Paris, a musical revolution took place expressing the genius of the new Gothic architecture in the world of sound: the monastic plainchant, with its single line of text, became polyphonic. Now two or even four different voice parts could overlap and interweave, making harmony together. This added whole new dimensions to the sound, and made possible an explosion of creativity in music that has still not exhausted itself. Written notation was developed to enable the singers to record and transmit their new harmonies more easily, and thus the revolution quickly spread throughout Christendom. As part-music reached a new level of complexity, the question of timing became increasingly important, leading to measured rhythm and new conceptions of musical form.

As plainchant and drone gave way to polyphony and chords, Pythagorean music theory evolved too. The sixteenth century divided the octave into twelve exactly equal parts (called the chromatic scale) to make it easier to tune an instrument. It eliminated the so-called "Pythagorean comma," a discrepancy—like those mentioned at the end of the last chapter—that occurs when tuning in perfect fifths (3:2 intervals). Twelve perfect fifths are almost but not exactly equal to seven perfect octaves, and the Pythagorean comma is the amount of the discrepancy. They can therefore be treated as the same interval by flattening (tempering) each fifth by a twelfth of a comma.[6]

Mathematically the octave, the fifth (five notes up from the note of the whole string), and the fourth (four notes up) are said to be the purest intervals, while the most consonant or harmonious are unison, of course (because it has a frequency ratio of 1:1), the octave (2:1), the major third (5:4), and the major sixth (8:5). Some say that the most beautiful interval is the major sixth, which, it will come as no surprise, happens to be a close aural approximation to the golden ratio ($8/5 = 1.6$).

The word "music" has acquired a rather more restricted meaning than it once had. Today we think of a musical piece as a piece of writing, whose author is known and which is generally performed for

6. The "comma" seems to correspond to the discrepancy between the months of the solar and lunar calendars, and so may have been taken to represent a distinction between heavenly and earthly harmony. See Barker 2003, 275–76.

aesthetic pleasure in a concert-hall setting. Music has been mechanized and packaged in ways typical of our society. As we saw earlier, among the Greeks the "art of the muses" enfolded the whole of intellectual and literary culture (as opposed to the physical culture of gymnastics), while even in its narrower meaning it included dance and poetry as well as singing and the playing of instruments. As such it was not a specialized study but a vital part of all humane learning, as well as being closely related to its companions in the *quadrivium*, arithmetic, geometry, and astronomy.

Polyphony did nothing to undermine that broader and deeper understanding of music that we see, long before the golden age of Western classical music, in Hugh of St. Victor's *Didascalicon* (c. 1130), where his chapter on the subject begins: "The varieties of music are three: that belonging to the universe, that belonging to man, and that which is instrumental." And he elaborates:

> Of the music of the universe, some is characteristic of the elements, some of the planets, some of the season: of the elements in their mass, number, and volume; of the planets in their situation, motion, and nature; of the seasons in days (in the alternation of day and night), in months (in the waxing and waning of the moons), and in years (in the succession of spring, summer, autumn, and winter).[7]

It is assumed here that to understand the universe is to appreciate its music, the harmonies between its parts, the rhythm of its movement, and the proportion of its elements. (The teaching goes back to Ptolemy's *Harmonics* in the second century, and of course to Pythagoras before him.) So too for what today we would call psychology and medicine: "Of the music of man," he says in the same place, "some is characteristic of the body, some of the soul, and some of the bond between the two." Music is characteristic of the body in its "vegetative" power (the power of growth), as well as through its composition and activity. It is "characteristic of the soul partly in its virtues, like justice, piety, and temperance; and partly in its powers, like reason, wrath, and concupiscence." Finally,

7. Hugh of St. Victor 1991, 69.

> The music between the body and the soul is that natural friendship by which the soul is leagued to the body, not in physical bonds, but in certain sympathetic relationships for the purpose of imparting motion and sensation to the body. Because of this friendship, it is written, "No man hates his own flesh." This music consists in loving one's flesh, but one's spirit more; in cherishing one's body, but not in destroying one's virtue.[8]

Since the twelfth century Western tonal music has evolved in so many directions that today it can be said there are as many kinds of music as there are moods and aspirations of the human heart. But perhaps it is still possible to find some underlying principles in the nature of man, as Hugh suggests with his attempt to relate different types of music to the different levels of the human organism. In the final chapter I will come back to the question of anthropology and the three fundamental levels we need to consider in this connection: body, soul, and spirit. Different sounds resonate in different parts of the body, so the natural symbolism of musical sound is related to the symbolism of the body itself, with the higher and purer notes often representing spiritual aspiration (even when played on the electric guitar), the lower bass notes connecting us more with the earth. There are styles of music that appeal to each of the three levels, and within each style or genre there may be an upward or a downward tendency. Rhythm connects us with the cycles of time and of biological life, while melody and lyrics, dynamics and texture evoke other ideas and associations across the whole range of human experience.[9]

There is also a close parallel between sound and light. In Sanskrit the roots of the words for "shine" and "sound" are the same, and in modern physics both are forms of vibration. Haydn linked each instru-

8. Ibid.

9. Recent research suggests human beings may be unique among animals in having a sense of rhythm, learning to synchronize their movements with an auditory beat. Neurologically this might be explained by a connection between the part of the brain concerned with movement and that concerned with hearing. No doubt an evolutionary reason can be invented to account for this. But the same facts can be "read" from the other side as expressing a metaphysical truth about man, whose attunement to the cosmos is part of his nature and necessary to his purpose.

ment in the orchestra to a distinct color (the trumpet scarlet, the flute sky blue, and so on), and Messiaen attempted musically—some would say unsuccessfully—to evoke the "perpetual dazzlement" of heaven and the New Jerusalem (Rev. 21:2, 10–27) that he glimpsed through the stained glass of St. Chapelle, describing his sonic language as intended to evoke a "theological rainbow."[10] It is for this reason too that J. R. R. Tolkien represented the creation of light in his mythological story "Ainulindalë" as a making-visible of angelic music. There are mysteries here that we need to explore further.

According to the English composer John Tavener (b. 1944),

> all music already exists. When God created the world he created everything. It's up to us as artists to find that music. Of course that's an exhausting experience, but you have to rid yourself of any preconceived idea about what music is; rid yourself of the idea that you *have* to struggle over note rows, or with sonata form, or the humanist bugbear, development. Music just is. It exists. If you have ears to hear, you'll hear it! . . . I believe we are incarnated in the image of God in this world in order for us to re-find that heavenly celestial music from which we have been separated. Our whole life is a continuing return to the "source." The fact that modernism can envisage no source is a very grave and catastrophic state of affairs.[11]

Tavener, of course, is a purist, and is, besides, talking mainly of sacred music. He believes that chant "is the nearest we can get to the music that was breathed into man when God created the world."[12] It must be sung, because "music is the extension of the Word, not a frilly decoration of the Word," and ideally (according to the Greek Orthodox Church which influenced him at this time) "there must be no harmony, no counterpoint, just a single melodic line with an *ison*, or the tonic note of the melody, representing eternity."[13] In fact he is not necessarily advocating a "return to chant," but stressing our need

10. Cited in Begbie 2008, 169. Jeremy Begbie's book is recommended for the reader who wants to investigate the religious dimensions of music.

11. Tavener 1999, 73–74, 98.

12. Ibid., 135–36.

13. Ibid., 48.

to learn from chant, and to aspire to produce again a kind of music that is transparent and timeless in that way.

Humane Architecture

For Hugh and the medievals, the ultimate concern of music, as of all the arts, "is with the changeless archetypal patterns in the divine Wisdom, to whose likeness the arts restore man."[14] Similar principles apply in the field of architecture. The conditions that make modernist architecture mechanistic and inhuman—in a word, ugly—are rooted in a philosophy of life that architects, by and large, have absorbed, accepted, and perpetuated along with everyone else.

You can see the problem while walking around any ancient city like Oxford, with its buildings of many periods and styles. What I will call "modernist" buildings (because they make a virtue of being modern, and therefore deliberately break with traditional principles of design) tend to be those which resemble concrete boxes, blockhouses and bunkers, or are composed of rectangular plate glass over metal and concrete frames. Children, with their fresher eyes, can recognize the ugliness of this kind of building when we adults sometimes cannot. But even when the buildings are made of brick or stone, the mean or gaping windows and the flat roofs of the modernist building give the game away.

One way of describing what happened to architecture is that the vertical dimension was devalued, or else that the link between the vertical and the horizontal had disintegrated. For there is a natural cosmic symbolism associating the vertical with the spirit, the horizontal with matter. The sky transcends us, the light from heaven illuminates us, the breezes from the sky refresh us, and the gales threaten our destruction. On the other hand, the horizontal is the dimension in which we walk, in which we reach out and touch the world around us, in which we exert our own dominion. These two dimensions are integrated in the human body, which as the medievals rightly perceived forms a "microcosm," a compact representation and sampler of the cosmos as a whole. We stand upright, and this very posture hints

14. Jerome Taylor, in a note to Hugh of St. Victor 1991, 196.

at our potential role as mediator or high priest of creation. We are divided symmetrically between left and right, because the horizontal is the world of division. Within the body, it is the face (and especially the eyes) that represents the soul.

In the first century BC, many of the classical traditions based on the symmetry and proportions of the human body were codified by Vitruvius. (His book was rediscovered in 1414 and had an enormous influence on the Renaissance.) In modern times, with the rise of rationalism and materialism, the transcendent or vertical dimension was neglected as we concentrated on mastering the world around us. At the same time, the significance of the human image was forgotten and man was regarded increasingly as no more than an animal, to be studied by the methods of science. Once these attitudes and assumptions had sufficiently penetrated the popular mentality, architects (along with other kinds of artists and designers) began to create buildings that reflected the modern understanding of man and the world; that is, machines for living in, spaces designed to facilitate efficient motion in a horizontal plane.

Though buildings now reached higher than ever before, skyscrapers were simply horizontal spaces piled one on top of another, with none of the mechanically replicated floors bearing much of an intrinsic relationship to the elevation in which they dwelt. The rectangular designs of the World Trade Centre and the UN building in New York were based on the mechanical repetition of one floor on top of another.[15]

In general, buildings that are flat tend to strike us as drab and ugly, while buildings with peaked roofs, with triangles and curves that connect the horizontal with the vertical, are felt to be more beautiful.[16] Decoration magnifies the effect. Proportions in windows and doors

15. Things are, of course, more complicated than this, and Manhattan's Chrysler and Empire State owe their iconic status partly to the fact that they do possess a form and decorative features that speak of integration and thus of beauty. Le Corbusier's design for the United Nations building, like much of his work, was based on the golden rectangle. Even the Trade Center did not lack a certain beauty (the beauty of a machine or a crystal), though less related by its proportions to the human body than the large buildings of earlier civilizations.

16. Again, a qualification is necessary. In many parts of the world, especially in hot climates, we see that flat roofs can be beautiful too, but there I would claim the

and their settings that echo the shape of the human form, and windows set into recesses or covered with arches that faintly echo the pattern of the eyes within the face, seem "right" to us because they speak at a deep level of the connection between the human person and the world as a whole. The materials of which we make our buildings are just as eloquent. Traditional materials such as wood, stone, or clay speak an immediate connection with the earth. On the other hand, concrete and cement by their very nature represent the brutality of modernism—the reduction of the world to particles in order to force it into shapes of our own devising. The shaping of concrete is done from the outside, by the imposition of mechanical force, rather than from inside by growth or natural accretion.

If we look at a modern city in this way, its underlying philosophy becomes more evident. It is a place where too many obvious features express the desire to control and manipulate, to herd and standardize. The human eye is held on the horizontal plane mainly in order to expose it to advertisements for things we might buy, and it is raised above that plane only to remind us that we are dwarfs in the face of technological power.

One of the aims of the European Enlightenment was "*mathesis*," or the spatializing of all knowledge, mapping the world onto a notional "grid" so that it could more easily be measured and controlled—effectively reducing the world to pure quantity.[17] With this went the attempted substitution of a concept of space for the concept of eternity, and with the attempt to achieve through frenetic activity or movement in space what can only really be attained through contemplation. Aspirations of this sort tend to be implicit in most drives toward greater efficiency, and lie at the root of the sense of ever-increasing stress and shortness of time with which modern man is afflicted.

Our contemporary cityscapes can be traced to a profound philosophical shift in Europe after the fourteenth century. Known as the *via moderna* (probably the first use of the term "modern"), the new-style nominalist philosophy associated particularly with Oxford's Duns

instinctive or traditional design of these buildings tends to make use of the vertical dimension in other ways, rather than simply ignore or suppress it.

17. Pickstock 1998, chap. 2. Cf. Guénon 2001b and Guardini 1998.

Scotus and William of Ockham located meaning and order not in the objective but in the subjective realm. Without the mediation of a world-order rooted in divine wisdom, the order of intelligibility had to be imposed on nature by the human mind. From being primarily receptive to reality, we gradually came to see our intelligence as constructive, as though the structure of the world depended on the way we saw and named it.[18]

Though I have referred to religious concepts, I have not yet been talking of sacred or church architecture, but only of the secular architecture that one might find on any street corner. The practical implications were summarized in 1989 by HRH Prince Charles in a book called *A Vision of Britain*.[19] His ten perennial principles for good architecture and town planning based on the concept of service and a sensitivity to the human meaning of buildings were as follows:

1. *Place*. By this he meant be sensitive to location and setting. One place is not the same as another. "Don't rape the landscape."
2. *Hierarchy*. The composition of a building should lead the eye to its most important elements. "If a building can't express itself, how can we understand it?"
3. *Scale*. "Buildings must relate first of all to human proportions and then respect the scale of the buildings around them."
4. *Harmony*. "Sing with the choir and not against it."
5. *Enclosure*. "A community spirit is born far more easily in a well-formed square or courtyard than in a random sampling of developers' plots."
6. *Materials*. "Let where it is be what it's made of."
7. *Decoration*. "We need to reinstate architecture as the mistress of the arts and crafts."
8. *Art*. "Sculpture and painting play an essential role in conferring on public buildings their unique social and symbolic identity, which architecture alone cannot."

18. Louis Dupré's *Passage to Modernity* gives a brilliant analysis of all these developments.

19. Charles 1989, 76–97.

9. *Signs and Lights*. "We should bury as many wires as possible and remember that when it comes to lighting and signs the standard solution is never enough."
10. *Community*. "Let the people who will have to live with what you build help guide your hand."

If we now focus more specifically on sacred buildings, we find that Michael S. Rose has attempted a summary of the principles of church architecture, reducing them to three in particular, which he calls *Verticality*, *Permanence*, and *Iconography*.[20]

In the case of Verticality Rose believes that "the massing of volumes upward . . . most readily creates an atmosphere of transcendence and, in turn, enables man to create a building that expresses a sense of the spiritual and the heavenly." I would add that monumental scale is not an essential element in this "massing." What is essential is that the natural symbolism of the vertical be taken into account, and that the vertical is used to add something qualitative, not merely quantitative, to the form of the church. Gothic architecture achieved its effects by a combination of height and light, evoking by its pointed and interlacing arches and columns the atmosphere that one might find beneath an ancient forest canopy, or within vast caverns under the earth. Byzantine architecture has a different feel entirely, even when the spaces within the building are huge. Here the heavens are closer, indeed seem almost wrapped around the worshipper. Either heaven has been brought to earth, or we have been raised to heaven. But both styles use space to express a theology.

The second of Rose's principles, Permanence, involves a similar use of the "fourth dimension," time. The transcendence of time by eternity, and by Christ as the incarnation of eternity in time, is suggested by the stability and durability of the church. An effective church building is a manifestation of tradition, and tradition is more than just the dead accumulation of custom; it is a living organism that overcomes time and death by a process of continual regeneration and gradual creative development. The church building, if it achieves permanence

20. Rose 2001, 15–29. He compares these to the traditional principles of Utility, Strength, and Beauty.

simply by resisting change and being preserved over centuries, might be no more than a museum or monument. But if it is built to last and is *sustained from within by a community of worshippers* then its permanence becomes a true reflection of eternity.

The third law of church architecture is Iconography, by which Rose means the capacity of the building to convey meaning not only by its overall form, but by the details of its composition and adornment. From the range of Christian iconography one should not exclude the whitewashed elegance of some Protestant and Nonconformist chapels, but what Rose has in mind primarily is the rich heritage of mosaics, frescos, stained glass, panels, and statues that are to be found in Catholic and Orthodox churches. Here again style, which is the organic expression of a living tradition, manifests theology.

Some years before his election as Pope in 2005, Benedict XVI wrote of the development of Christian iconography as follows:

> But now the idea awakens in Christianity that precisely God's incarnation was his entry into matter, the beginning of a momentous movement in which all matter is to become a vessel for the Word, but also in which the Word consistently has to make a statement about itself in matter, has to surrender itself to matter in order to be in a position to transform it. As a consequence, Christians are now deriving pleasure from making faith visible, from constructing its symbol in the world of matter. The other basic idea is connected to this: the idea of glorification, the attempt to turn the earth into praise, right down to the stones themselves, and thus to anticipate the world to come. The buildings in which faith is expressed are, as it were, a visualized hope and a confident statement of what can come to be, projected into the present.[21]

Church architect Steven J. Schloeder has discussed the "Church as Icon" in his book, *Architecture in Communion*. A church by its very nature is a symbolic structure, and that symbolism potentially includes its cosmic situation, its orientation in relation to the sun and stars,[22] as much as the details of its workmanship and decoration both inside and out. A church is intended to be read like a book—to evoke and provoke contemplation, which is the inward journey. Unfortunately,

21. Ratzinger 1996, 88.
22. See Ratzinger 2000, 62–84; Lang 2004.

modern man has largely lost the ability to turn the pages, let alone read the language of symbolism.

In the case of the Gothic, a deliberate attempt was made by its twelfth-century inventor, Abbot Suger, to incarnate the vision of the New Jerusalem from the twenty-first chapter of the book of Revelation.[23] Precious stones were placed in the walls, and the overall impression of light flowing through the huge windows was designed to evoke the luminous crystalline appearance of the Holy City, whose "wall was built of jasper, while the city was pure gold, clear as glass" (Rev. 21:18). The Gothic Cathedral, indeed, in its ordered complexity, resembled a city more than it did a temple within a city. Or else it combined the two ideas, like the New Jerusalem itself. It was a microcosmic model of the universe, as befitted the body of God. And its ordering principles included the Pythagorean and Euclidean mathematics that Suger had inherited from the ancient Greeks by way of Boethius and the Arabs. It was in fact the Arabs who had first developed a form of architecture involving pointed arches, and increased contact with the Muslim world during the Crusades led to this style being adopted gradually in the West, replacing the rounded arches of the Romanesque. When Chartres cathedral burned down and had to be rebuilt in 1145, Adelard's translation of Euclid (the major text of ancient Greek geometry, until then completely unknown in the West) was being taught in the schools, and especially in the school of Chartres. Other innovations, such as flying buttresses and large stained glass windows, developed from this.

Of Suger's prototypical Gothic church of Saint-Denis, Schloeder writes: "Here is a church with integrity in its structural elements, perfect proportion in its ruling geometries, and a radiance that activates its material composition."[24] Integrity, radiance, and proportion were the three elements of beauty as defined later by St. Thomas. The concept of "integrity" here refers not merely to a kind of internal coherence, but to

23. On all this, with the relevant quotations from Abbot Suger and Bishop Durandus, see Schloeder 1998, 187–208. Much more detail on the Gothic specifically is provided in Burckhardt 1995, and Mâle 1958, as well as the classic thirteenth-century work by Durandus himself, *The Rationale Divinorum Officiorum*. Hani 2007 provides an impressive synthesis of this tradition.

24. Schloeder 1998, 199.

the kind of perfection a thing attains when it has all it needs to be itself, to perform its authentic function (in this case, to facilitate prayer).

None of this is to say that an authentic church architecture for today will be modeled on the Gothic. According to Rudolf Wittkower, medieval architects tended to build on *geometrical* principles, using circles, squares, triangles, and pentagons, whereas Renaissance architects preferred *arithmetical* principles, epitomized in the simple ratios of the musical scale.[25] Both could appeal to the Pythagorean tradition and the *Timaeus*, but Renaissance architecture attempted to implant musical harmony directly into stone in a way the earlier period did not. As a result, Renaissance architects were less interested in irrationals such as the golden ratio or $\sqrt{2}$ and $\sqrt{3}$ (the latter, which featured in the design of the Gothic cathedrals, being the diagonals of a square and cube respectively whose sides are one unit long), preferring the rational numbers of musical harmony.

Wittkower notes the other main differences: the Gothic floorplan echoed the form of Christ's human body on the Cross, and the distance between heaven and earth was expressed in vertical elongation, whereas the Renaissance, influenced by the Greek Cross of Byzantium, preferred the circular form (a square base topped by a dome) as though peering directly at divine perfection. Another shift took place in the Baroque. While the Renaissance had aimed at perfect harmony, the Baroque was a period of agitation and ecstasy. Reflecting the mood of Romanticism, as well as the cosmology of the period, its architects deliberately employed discord to express tension, feeling, and movement everywhere (albeit mystically resolved in the heavenly choirs of angels and representations of the Trinity)—demonstrating "a new *conception of space directed towards infinity*: form is dissolved in favour of the *magic spell of light*."[26]

The traditional principles of harmony in building are not obscure, but they can be applied in many different ways—perhaps in ways not yet imagined. Architects like Christopher Alexander, Duncan G. Stroik, Stephen J. Schloeder, and Daniel Lee are rediscovering the secrets of humane architecture. In architecture as in

25. Wittkower 1998.
26. Wölfflin 1984, 64.

music, we are beginning to appreciate once more the importance of formal beauty.

At Home in the Cosmos

The word "ecology" was coined only as recently as 1873, by the German zoologist Ernst Haeckel. He based it on the Greek word *oikos* meaning "house, dwelling place, habitation" (plus, of course, *logos*). But though the scientific study of ecology, referring to the complex interrelationships of biological entities with each other and with their environment, is a modern development, the traditional worldview has a great deal to say on the matter. The medievals did not possess posters showing the fragile earth floating in a dark sea of space, but the principles underlying the *quadrivium*, even today, can help us learn to dwell more wisely in our common home.

We often talk about the "environmental movement," or about a modern concern for the "environment." It is worth noting that these terms are misleading, since they imply an opposition between humanity (or whichever species is under discussion) and its surroundings, reducing the rest of nature to a kind of backdrop—and at worst to a complex set of raw materials and mechanical forces. The insight that ecologists have come to in the second half of the last century runs counter to this view. It reveals the interdependence of all living things in a world that is more than a mechanism, more than the sum of its parts, perhaps even in some sense alive in its own right. But this is little more than a rediscovery in scientific terms of what had already been understood "poetically" in all previous civilizations. C. S. Lewis, who knew and loved the medieval universe, describes it as "tingling with anthropomorphic life, dancing, ceremonial, a festival not a machine."[27]

The full weight of Lewis's statement will only be felt when we come to the last chapter of this book, but for now the point is that for our preindustrial ancestors the world was not a machine. It was an

27. Cited in Ward 2008, 24. Michael Ward shows that each of Lewis's seven Narnian chronicles was organized around characteristics associated with one of the seven traditional "planets," which he regarded as spiritual symbols of permanent value.

organic whole, ordered from within, animated by a hierarchy of souls, perhaps even by a "world soul." This is not pantheism, although it could become so once the transcendence of God had been forgotten. It meant that nature possessed a sacred and spiritual value, by virtue of its creation by God and the immanent presence of God within it. The world was a book, pregnant with meanings that God had placed there. All things, even the conjectured world soul, were creatures. The stars were angelic creatures, the movements of their high dance helping to determine the pattern of events unfolding below. The elements themselves were conscious beings, according to the sense of analogy, participating in their own way in the cosmic intelligence. Admittedly, St. Francis of Assisi was hardly a typical medieval man, but his ability to address the animals and even the elements in personal terms—easily dismissed by a modern mentality as superstitious nonsense and the "pathetic fallacy"—was the intensified version of an experience that seems to have been commonplace.

> All praise be yours, My Lord, through Brothers Wind and Air,
> And fair and stormy, all the weather's moods,
> By which you cherish all that you have made.
>
> All praise be yours, my Lord, through Sister Water,
> So useful, lowly, precious and pure.
>
> All praise be yours, my Lord, through Brother Fire,
> Through whom you brighten up the night.
> How beautiful is he, how gay! Full of power and strength.
>
> All praise be yours, my Lord, through Sister Earth, our
> mother,
> Who feeds us in her sovereignty, and produces
> Various fruits with colored flowers and herbs.

This extract from the *Canticle of Brother Sun* may be the expression of a new outburst of spiritual feeling for nature, but it is in strictest continuity with many parts of the Christian and Hebrew tradition. The Canticle of Daniel, for example, calls upon all of creation to bless the Lord, including the sun and moon, stars of the heavens, clouds

of the sky, showers and rain.[28] For G. K. Chesterton in *St. Francis of Assisi*, the saint was able to attain such pure joy in the things of nature precisely because Christianity had spent the previous millennium trying to purify the world of degenerate forms of paganism that had enslaved man to the living forces of nature, including his own lower nature. Now the natural world could again—in the eyes of a saint—appear as it once was and in its essence always remains, a Garden of Eden. Just as the animals obeyed Adam and permitted him to name them, so the wolf would lay his paw in the hand of Francis, and on one notable occasion a red hot poker would at his request decline to inflict pain on the man who had addressed it with such courtesy.

The animals, plants, and minerals, the stars and elements, were universally thought to "praise" their maker, either simply by their very existence, or when called upon to do so by man (who gives them a voice they do not possess in themselves). Man, as a microcosm containing in himself all the elements of nature and faculties or powers corresponding to both animals and angels, occupied a central place in the universe. It was because of his ontological importance in the order of being that medieval astronomers placed him at the center.[29] They understood—and the earlier church fathers may have understood even better—that Adam's role in the cosmos was a priestly and mediatory one from the beginning. That role had been restored in Christ, who by assuming human nature had in a way assumed *the whole of nature* by taking on a body.

They may not have had (or needed) the term "ecology," but the ancient writers were deeply aware of the interrelatedness of the natural world, and of man as the focus or nexus of that world, which they expressed in the doctrine of correspondences. It was, of course, more poetic than scientific in its formulation, but it expressed a profound insight that remains valid, and the present ecological crisis could only have developed in a world that has forgotten it, or forgotten to live by it. The fundamental human act is prayer, which is the remembrance and

28. Dan. 3:57–88, 56.

29. Modern thought tends to regard man as nothing more than an animal, but implicitly admits his centrality by making him solely responsible for the destruction of the biosphere.

invocation of God (as Simone Weil would say, prayer is "attention").[30] This act is that by which heaven and earth are linked together, and most religious traditions of mankind would agree that it is what keeps the world in existence—it is only when the last person ceases to remember God that the end will come. The harmony of creation depends upon it: once the created world is no longer "attuned" by our prayer to the heavenly harmonies that transcend hearing, only chaos can follow, and the war of one element against another. The Wisdom of Solomon is full of such admonitions. "For creation, serving thee who hast made it, exerts itself to punish the unrighteous, and in kindness relaxes on behalf of those who trust in thee" (Wis. 16:24).[31]

One implication from the doctrine that man is a microcosm, a "little world," is that the disorder in the macrocosm is *our fault*, being a reflection or projection of our own interior dis-ease. When Adam fell from grace, the whole creation was somehow dis-graced, or put out of joint. The healing of the world therefore cannot be envisaged without a reordering and a healing of the inner world of imagination, intelligence, and will. This intuition is easy to relate to the modern study of ecology and to the broader development of a more holistic worldview in postmodern science. As such it also provides a point of entry for understanding the tradition of virtue ethics. It is hard to develop an adequate moral theory based on rights alone that can address the need to conserve natural resources and biodiversity—although attempts have been made to formulate rights for animals and for future generations. It is easier for the average person to think in terms of the need to act virtuously, both with regard to animals and with regard to our use of material things. The damage we wreak in the world is much more obviously the result of cruelty, greed, selfishness, and impatience than it is the violation of some implicit legal code of rights. By putting the emphasis back on our own integrity,

30. The Catholic Mass or Orthodox Divine Liturgy is the highest form of such invocation, *anamnesis*, and mediation.

31. Pico della Mirandola, who summed so much of the Christian-Pythagorean tradition in the late fifteenth century, writes along these lines: "It is reasonable that to the same extent that we do injury not only to ourselves but to the universe, which we encompass within us, and to almighty God, the creator of the world itself, we should also experience all things in the world as the most severe punishers and powerful avengers of injuries, with God among the foremost" (Pico 1965, 136).

and on the cardinal virtues of prudence, justice, temperance, and fortitude, we are laying the foundation for a way of life that would be truly sustainable over time.[32]

It is easy to romanticize past ages as times of ecological harmony simply because they did not possess the technology to do the kind of harm we inflict so easily. Human nature was the same then as now, and was certainly not unfallen in the Middle Ages. Nevertheless, there is an objective difference between a way of life limited in the damage it can inflict on creation, and a way of life founded on the unlimited aspiration to consume and enjoy, one also equipped with the means to change the planet in unpredictable ways. The stability of a preindustrial economy is one thing; our task is to achieve a similar stability in a postindustrial age, and the challenge may seem impossible. We can start by recognizing in our own hearts the tendencies that lead to greed, injustice, and destruction. Then we must seek to ensure these tendencies do not determine our technology and our economy.

Secrets of the Sky

As we have seen, observance of the laws of harmony has been traditionally believed to attune the soul to a heavenly ideal. The spheres associated with the planets, representing levels of the universe or the elements in its construction, were thought to be moved by angels. Each sang a certain note, together expressing the harmony of the

32. For a detailed survey of the metaphysical and historical roots of the ecological crisis see Nasr 1996. This book by a Muslim scholar extends the analysis already found in his groundbreaking early work, *The Encounter of Man and Nature*, which was based on lectures given as early as 1966. Christian treatments of the roots of the crisis have taken awhile to catch up, although Romano Guardini's *Letters from Lake Como*, written in the 1920s, already goes to the heart of the matter, and the writings of E. F. Schumacher in the 1970s made an important contribution. Paulos Mar Gregorios worked out an ecological theology in the tradition of Gregory of Nyssa and Maximus the Confessor for the World Council of Churches in 1987, published as *The Human Presence*. Catholic teaching on ecological responsibility was summarized in *The Compendium of the Social Doctrine of the Church* (Vatican, 2004), and by Cahal B. Daly in *The Minding of Planet Earth* in the same year.

universe; a harmony that may be transmitted through music to the human soul.

The idea was famously expressed by Lorenzo, a character in Shakespeare's *Merchant of Venice*, gazing up at the starry sky from the garden of Belmont, a villa near Venice:

> Look how the floor of Heaven
> Is thick inlaid with patines of bright gold
> There's not the smallest orb that thou beholdest
> But in his motion like an angel sings
> Still quiring to the young-eyed cherubims
> Such harmony is in immortal souls.
> But, while this muddy vesture of decay
> Doth grossly close it in, we cannot hear it.[33]

According to C. S. Lewis, the music of the spheres

> is the only sound which has never for one split second ceased in any part of the universe; with this positive we have no negative to contrast. Presumably if (*per impossibile*) it ever did stop, then with terror and dismay, with a dislocation of our whole auditory life, we should feel that the bottom had dropped out of our lives. But it never does. The music which is too familiar to be heard enfolds us day and night and in all ages.[34]

The last great attempt to discover the ultimate secret of the universe in a grand synthesis of geometry, music, astrology, and astronomy was Johannes Kepler's *Harmonices Mundi* ("The Harmonies of the World"), published in 1618. The history of this achievement is enormously instructive. Kepler (d. 1630), like his predecessor Copernicus, was a fervent Pythagorean, and it was a belief in the causal role of perfect geometrical and numerical forms in nature that drove his intellectual quest.

> Why waste words? Geometry existed before the Creation, is co-eternal with the mind of God, *is God himself* (what exists in God that is not God himself?); geometry provided God with a model for the Creation

33. *The Merchant of Venice*, act 5, scene 1.
34. Cited in Ward 2008, 21.

> and was implanted into man, together with God's own likeness—and not merely conveyed to his mind through the eyes.[35]

The hypothesis of a sun-centered planetary system, as opposed to an earth-centered one, was developed not because it could explain the observed facts more accurately (for at first it could not) but for aesthetic and symbolic reasons. But it was Kepler's Christianity, in combination with his Pythagorean enthusiasm, that made possible the birth of modern science.[36] The problem with the traditional method of relating everything to the simple mathematical archetypes of Pythagorean numerology and harmony is that if you *start* with the archetypes and try to deduce the forms and movements of the universe you will almost certainly go wrong—and you will end up having to bend the facts to reconcile them with your empirical observations. The traditional method is not pragmatic, after all, but contemplative. It is not oriented toward the practical. Science in the modern sense was born when Kepler began to give the same weight to empirical observation as to his theoretical concerns, and that was related to his conviction that a benign Creator was responsible for the way the world worked, on earth as well as in heaven.

If, as many of the ancients believed, the material and changeable world is merely an imperfect shadow of the unchanging eternal, we can hardly hope to find matter conforming perfectly to mathematical laws. So it was that by Kepler's time it was accepted that mathematical devices (such as epicycles) could be used by astronomers to predict the movements of the heavens, without anyone really believing that they existed in reality. Astronomy was not concerned with finding physical explanations for things. After all, what cause is needed, other than God? Astronomers were concerned exclusively with "saving the appearances" by finding accurate ways

35. Kepler, cited in Koestler 1989, 264. Koestler's Kepler is an attractive if bumbling character—he describes himself as a "foolish bird." I particularly identify with his "peculiar kind of memory which makes him promptly forget everything he is not interested in, but which is quite wonderful in relating one idea to another" (243).

36. It was Isaac Newton who later found the hidden connections between these three laws of planetary motion, in the form of his theory of gravity. For example, the first law—that the planetary orbits are ellipses—is due to the inverse square law relating force to distance.

of analyzing heavenly movements into their component circles—that is, devising mathematical descriptions of these appearances using perfect circles without assuming any physical explanation of them whatever.[37]

Kepler's breakthrough came because he introduced a "why?" question where the astronomers of his day didn't see the need for one. He sought physical causes for heavenly motions. And that was not because he believed less in God as the cause of everything, but because he had more respect for the physical world as God's creation and as the image of God's mind. It was the first step toward Newton's cosmos, in which the same universal laws (such as gravity) governed both the earth and the heavens.

Take the orbits of the planets, for example. At the age of twenty-five Kepler thought he had discovered that the orbits of the six visible planets orbiting the sun (Mercury, Venus, Earth, Mars, Jupiter, Saturn) fit beautifully within the five Platonic solids, arranged one inside another. This would explain why there are precisely six, and not more, and why they orbit where they do. Of course, we now know there are more planets than those visible to the naked eye. Koestler calls this a classic example of "false inspiration" that nevertheless triggered a series of breakthroughs that proved to be of lasting importance.

Unfortunately for Kepler's peace of mind, the fit between the orbits and the Platonic solids proved to be inexact, according to the data he had taken from Copernicus. His continuing unease with these discrepancies drove him to seek out the much more accurate observations of Tycho Brahe, whom he met early in the year 1600. Out of this meeting of two great astronomers eventually came Kepler's *New Astronomy*, his physics of the sky, in 1609. In that book he reports his discovery that the planets move around the sun not in the perfect circles that seemed most appropriate to celestial bodies, but in ellipses. At one point he compared this to finding a "load of dung" in the heavens.

37. There may have been more to Kepler's poetic intuitions (what Koestler calls his "Baroque fantasies" and Burtt calls "crude inherited superstitions") than conventional wisdom allows. John Martineau and Richard Heath have recently shown that Kepler's intuition about the relations of the planetary orbits to the Platonic solids were not so far off the mark after all (see www.woodenbooks.com).

Pure deduction from an aesthetic ideal had gone astray, but careful observation and measurement had led to a correct conclusion seemingly at odds with traditional cosmology.

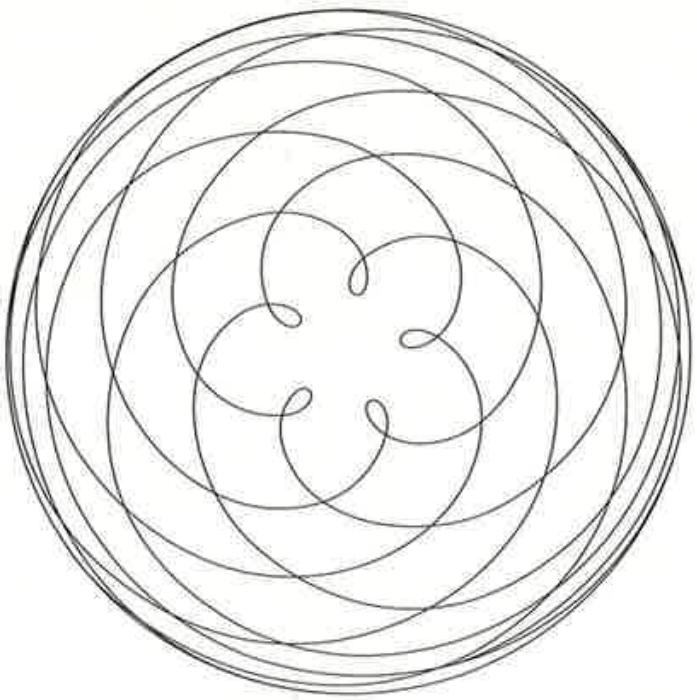
The irony is that if we contemplate the *result* of this observation, we find that an unexpected beauty reveals itself. For the medieval astronomers were wrong: there is actually nothing imperfect about an ellipse. It differs from a circle by having two centers or foci rather than one (the sun occupying one of them), so that the sum of the distances from any point on the circumference to the two centers remains constant. Thus the planetary orbit is determined by two centers, the visible and the invisible, just as the life of any creature must revolve around the incarnate Logos and the invisible Father. What could be more elegant? Or as Kepler came to see, if the circle represents "transcendental" perfection, and the straight line represents the created world, an ellipse (as the combination of the two) represents perfectly the incarnation of the ideal in the created order. Kepler's original mistake did not lie in his Christian Pythagoreanism, but in his attempt to prejudge the mathematical forms he would find in nature. He should have been happy to be led by observation, confident that what he discovered would (eventually) turn out to have appropriate symbolic properties.

In order to make Pythagorean sense out of these strange elliptical movements in the sky, Kepler tried to reconcile the orbits of the planets with the classical harmonic proportions. He eventually found the correspondence he was looking for in the variations of the *angular velocities* of the planets as seen from the sun, by comparing the speed at which they were traveling at different parts of their orbits. This is an example of the right way of doing things: to look at what really happens, and discover the beauty in it.

Kepler had now discovered the first two of his immortal "three laws" of planetary motion. The third came to him as he tried to find the relationship between a planet's period around the sun and its distance. Kepler thought there had to be a connection, if the sun was indeed master of the solar system. It turned out that the *square* of the period is proportional to the *cube* of the mean distance. Not intuitively obvious, but beautiful nonetheless.

As Koestler tells Kepler's story, the harmonies he searched for and eventually found were psychologically but not otherwise particularly significant. They lured him onward, but the more important Pythagorean insight that he had revived after a millennium and a half of neglect was simply that mathematical relations hold the secret of the universe—the *whole* universe, above and below the moon—and need to be uncovered by precise empirical observation.

The Ptolemaic astronomers, assuming circular motion with the earth stationary at the center, had tried to account for the retrogression of the planets against the stars by means of a complex pattern of epicycles and deferents—wheels within wheels. We do not have to revert to their geocentric description to appreciate simple patterns that reveal themselves in the relative motion of the planets, as they pursue their separate eccentric paths around the sun, each at a different speed. Not only are the periods of the planets related to each other in fairly precise harmonic proportions (2:5 in the case of Jupiter and Saturn, for example, and 1:Φ in the case of Earth and Venus), but each traces a lovely sequence of loops around the other that reveal aspects of their geometrical relationship. Venus and Earth produce a particularly beautiful five-petaled "flower" containing a pentagram of close conjunctions over 8 years (13 Venusian years).



Thus the solar system as understood and measured by modern astronomers abounds with beauty that would warm the heart of any Christian Pythagorean. One final example: ancient and medieval geometers were tantalized by the problem of "squaring the circle," which meant finding the square whose perimeter (or alternatively area) measured exactly the same as that of a given circle. It is one of the strange coincidences in which the solar system abounds that the problem is "solved" by the respective sizes of the earth and the moon, which are in the ratio of 11:3. Thus if the moon were rolled around the earth's surface, its center would describe a circle equal to the perimeter of a square inscribed around the earth (31,680 miles).[38]

The harmonics of the planetary orbits are well known. Something analogous must surely apply within the subatomic world (quantum harmonics?), since all energy is a kind of vibration. These different levels of creation—the macro- and the micro-world, with humanity between—are

38. For more on all this, see Martineau 2006 and Schneider 2006.

bound up in a single whole. It has often been remarked that if any of the main physical constants (such as one of the four fundamental forces of nature, Planck's constant, or the speed of light) had been slightly different than they are, the universe could not have developed into a suitable habitation for life. In this sense too the cosmos is a beautifully ordered whole, precisely tuned to permit human existence.[39]

Everywhere we look in nature, we tend to find structure or form. The planets occupy distinct orbits, rotating in close numerical relation to one another. Materials vibrate at certain frequencies that harmonize together. Electrons fall into distinct "shells" around the nucleus of the atom, jumping from one level to another depending on the units of energy they acquire. In evolutionary biology, creatures do not appear randomly across the whole range of physical possibility, but fall into families and species each of which expresses a particular type of creaturehood. All these distinct forms we observe in the universe indicate what Pope Benedict calls the "inner design of its fabric."[40] They can be read as approximations to the fundamental "ideas" that lie behind the creation. Thus even today the concept of harmony developed by the Pythagoreans can help us understand the way the unity and diversity of the world unfolds.

The End of the Road

Music, architecture, astronomy, and physics—the physical arts and their applications—demonstrate the fundamental intuition behind the Liberal Arts tradition of education, which is that the world is an ordered whole, a "cosmos," whose beauty becomes more apparent the more carefully and deeply we study it. By preparing ourselves

39. The so-called "anthropic principle." Some scientists attempt to escape the obvious implications by positing the existence of multiple domains or universes, making it entirely natural that we would find ourselves in the one that happens to support human life. This is a pretty desperate move. By the way, an extension of the anthropic principle would state that the world's physical structure is the way it is not only in order to support human life, but *to communicate metaphysical truths to us symbolically*. In other words we are justified in reading something into the symbolism of the sun "rising" and "setting," even if we know that it is the earth that moves around the sun.

40. Ratzinger 1995a, 26.

in this way to contemplate the higher mysteries of philosophy and theology, we become more alive, more fully human. This beautiful order can be studied at every level and in every context, from the patterns made by cloud formation or river erosion to that of the leaves around the stem of the most obnoxious weed, from the shape of the human face as it catches the light, or the way keys are ordered in a concerto by Bach, to the collision of stellar nebulae and particles in an atomic furnace.

Yet at the same time, while studying and appreciating the intuitions that lay behind the cosmological sciences of the *quadrivium*, we cannot today simply revert to the worldview of the Middle Ages. The ancient mathematical theories of music and astronomy contain elements we need to retrieve, but they were not themselves entirely adequate. In his theological study of Western tonal music, Jeremy Begbie asks, in the Great Tradition stemming from Pythagoras,

> Is the created world being treated as able to glorify God *in its own way*, by virtue of its own distinctive patterns, rhythms, and movements? Many have argued that the streams of thought that guided much medieval thinking about music did not pay enough attention to the distinctive order and harmony of the universe as it is and as it could be. Out of a keenness to assume direct and necessary correspondences between the created world and God, to preserve (in some cases) a "hierarchy of being," it is debateable whether the structures of creation were always being respected in their full integrity and potential.[41]

We have seen that question arise in connection with astronomy too. Yet in noting the shift in our modern thinking "*from the cosmological to the anthropological*, from justifying music in terms of the cosmos at large to justifying it solely in terms of human needs and aspirations"[42] (and for all his slight suspicion of the influence of "Platonic" otherworldliness on the arts), Begbie wonders if something immensely valuable has been lost along the way.

41. Begbie 2008, 92–93.
42. Ibid., 94.

> For all that we might smile benignly at in the mathematical clumsiness and rhetorical hyperbole of the classical philosopher of music or the intellectual abstractions and tetchy fussiness of the medieval theorist, is there not something in the notion of being "cradled" in God's created *harmonia* that is worth recovering?[43]

In late 2007, the themes I have been discussing in this book hit the headlines all over the world when a maverick physicist, Garrett Lisi, published online a paper entitled "An Exceptionally Simple Theory of Everything."[44] In it, he suggested all known subatomic particles and forces (and a few unknown ones, which he predicted would be found by the Large Hadron Collider in Switzerland) could be located on a matrix provided by E8, an eight-dimensional shape discovered in 1887 that is regarded as the most elegant and intricate example of mathematical symmetry. As Lisi put it in the online paper, he had devised "a comprehensive unification program, describing all fields of the standard model and gravity as parts of a uniquely beautiful mathematical structure. The principal bundle connection and its curvature describe how the E8 manifold twists and turns over spacetime, reproducing all known fields and dynamics through pure geometry."

The theory was incomplete, and the predictions still to be tested, but what makes this interesting is the philosophy of science that lies behind it. "We exist in a universe described by mathematics," wrote Lisi. "But which math? Although it is interesting to consider that the universe may be the physical instantiation of all mathematics, there is a classic principle for restricting the possibilities: The mathematics of the universe should be beautiful. A successful description of nature should be a concise, elegant, unified mathematical structure consistent with experience."

43. Ibid., 95. On the previous page he quotes Daniel Chua's striking comment, "The harmony of the spheres has collapsed into the song of the self." He concludes that the "broad intuition" and "persistent concern" of the Great Tradition, "to construe the making and hearing of musical sounds as grounded in divinely bestowed matrices of order," is "surely correct and not to be sacrificed thoughtlessly" (233–34).

44. http://arxiv.org/PS_cache/arxiv/pdf/0711/0711.0770v1.pdf

Lisi's particular theory failed, but the drive of science is in this direction. Others will try, guided by the same intuition that *the truth is beautiful*, the same compulsion to discover *the truth in beauty*. But as Stephen M. Barr has pointed out, if science can explain the design of the world by discovering a deeper and simpler design among the laws of nature, it still "has no way to explain the ultimate design of nature."[45] Armed with a convincing Theory of Everything, it will have reached the end of the road of science. But the end of the road is the beginning of another and wider landscape. Science can discover the laws of nature, but not why they are that way, nor why there is anything to obey them. That is why cosmology leads only to the threshold of theology.

45. Barr 2003, 106. See also the work of the 2008 Templeton prizewinner, the distinguished priest-physicist Michael Heller, on the mystery of the world's comprehensibility in "Chaos, Probability, and the Comprehensibility of the World," available online at www.templetonprize.org. Heller's statement at the Templeton news conference on March 12, 2008 (available on the same site) summarizes some of his significant insights. To ask about the cause of the universe is not to ask for "a cause like all other causes" but "the root of all possible causes," and therefore "a cause of mathematical laws." Contrary to the exponents of evolution by "Intelligent Design," he argues, *chance* should not be considered a rival to *design*. "Chance and random processes are elements of the mathematical blueprint of the universe in the same way as other aspects of the world architecture." Both are woven together in the symphony of creation. "Elements of necessity determine the pattern of possibilities and dynamical paths of becoming, but they leave enough room for chancy events to make this becoming rich and individual." In a striking phrase, he speaks of the greatest mystery of all being the "entanglement of the Human Mind with the Mind of God."