

IN THIS SECTION:

Another significant gathering was held in Ann Arbor, Michigan: the Natural Science Section of the School for Spiritual Science in North America, celebrating Rudolf Steiner's further development of Goethe's holistic science impulse.

Frederick Amrine shares his lecture to that gathering; its very important insight is that anthroposophy has been well developed on the discovery side of science where "beauty" is a well-accepted criterion.

Douglas Sloan taught education and history of religion at Columbia Teachers' College; here he looks to our animal companions and our deep and unmet responsibilities to them.

Adonis Press brings us a remarkable book of poems—*Honeymoon of Mourning*—which have found an ideal translator in Matthew Dexter.

Evolving Science & the Task of the Natural Science Section

A report on the annual conference of the Natural Science Section at the Rudolf Steiner House in Ann Arbor, MI, from December 1–4, 2016

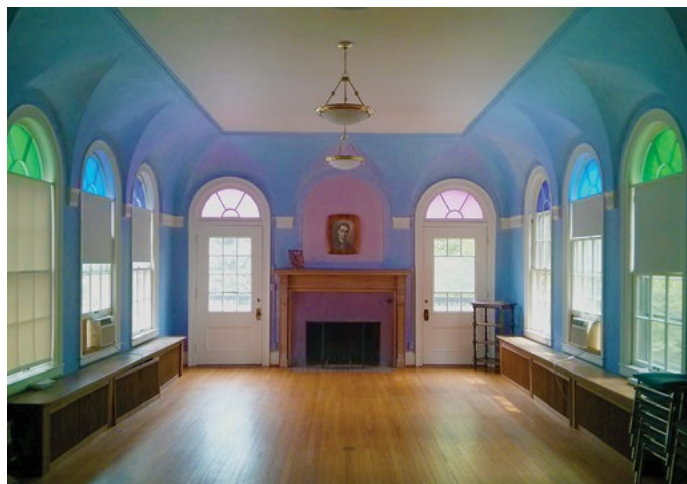
Aside from considering new developments in science, this year's Natural Science Section conference focused on the task of the Section and on building an active scientific community around our work on Goethean science. Our efforts were blessed by the fact that a special constellation of key people agreed to participate in the conference. We were also inspired by memories of pioneering individuals on the other side of the threshold such as Ernst Katz, Seyhan Ege, Stephen Edelglass, and Georg Maier, and we were encouraged by the good wishes of colleagues such as Mark Riegner, Walter Goldstein, and others who were unable to attend. Those of us who have been carrying the work and attending the annual conferences of the Section over the past years felt that our focus on building the inner capacities necessary for the further evolution of science also contributed to the special quality and success of the conference.

The Rudolf Steiner House in Ann Arbor provided an ideal setting for the conference. With its welcoming, helpful staff and spaces permeated by many years of anthroposophical activity, it is well suited to a conference of up to 25 people.

On the Wednesday evening before the conference began, Andrew Linnell gave a thought-provoking talk on technology and its role in human evolution. The conference began on Thursday with efforts to approach our theme through work based on the content of the First Class. Led by Barry Lia, John Barnes, and Douglas Miller, we considered the path and inner development of the scientist, steps toward establishing a qualitative science, and Rudolf Steiner's suggestion that "the lab bench must become an altar." On Thursday evening, Friday and Saturday, we heard stimulating talks that were open to the public:

- Fred Amrine on beauty as a fundamental aspect of good science and "What is scientific about Spiritual Science?" (see next article)
- Craig Holdrege on overcoming the limitations of superficial abstract thought and encountering the actual beings of Nature
- Johannes Köhl on approaching the etheric through light and electricity
- Arthur Zajonc on the practice of contemplative inquiry and physics today
- and Gopi Krishna on Goethean science and Dewey Larson's reciprocal system.

In addition, each participant reported on his or her own scientific work. Beside those already mentioned, those who presented were: Frank Fawcett and Jerry Kruse on the forthcoming book by geologist Dankmar Bosse about human and earth evolution, and on collaborative work in geology; John Petering and Judith Erb on teaching chemistry through phenomena and song (!); Jennifer Greene on water research and its application in waste water treatment; John Bowditch on bringing science and technology alive in museums; Jeremy



The hall at Rudolf Steiner House, Ann Arbor, Michigan.

Strawn on spreading enthusiasm for projective geometry; and Michael Shupe on designing and setting up a scientific experiment. Barry Lia presented his research on the hidden morphology of the retina in relation to behavioral specialization and the ancient notion of an etheric streaming from eye to object. Each presentation was followed by lively conversation, which also bubbled up freely over meals shared in the dining room and on invigorating walks in the nearby arboretum.

The mood of the conference was pervaded by a sense of being part of a momentous development in the evolution of modern science and an awareness that we are working at thresholds, the crossing of which will require the total engagement and transformation of our own being. Associated with this was an awareness of forming a working scientific community, which became particularly apparent toward the end of the conference when we decided to take up a study of, and contribute to a commentary on, the eighteen lectures Rudolf Steiner gave on *Interdisciplinary Astronomy* (CW 323), which Fred Amrine has re-translated and which will soon be published

by SteinerBooks. The plan is that our next annual Science Section conference in 2017 will focus on this challenging work. We have already reserved the Rudolf Steiner House for November 9-12, 2017 for the conference. Another promising outcome of the conference was that Mark Riegner and John Petering have agreed to work together on editing a new science journal.

At the Science Section's business meeting on Sunday morning the four members of the Section's Steering Group—Jennifer Greene, John Barnes, Barry Lia, and Andrew Linnell—agreed to continue on, joined when needed by Judith Erb in their regular Monday morning conference calls. We were also pleased to hear that the conference had broken even financially. Thus at a time of tremendous challenges we left the conference with gratitude toward our hosts in Ann Arbor and with renewed courage and confidence in the importance of our work.

John Barnes, Jennifer Greene, Barry Lia, Andrew Linnell and
Judith Erb for the Natural Science Section's Steering Group

The Beauty of Anthroposophy, or: What's Scientific about Spiritual Science?

by Frederick Amrine

Science involves the interplay of intelligibility, discovery, and justification. Intelligibility runs the gamut from prediction to the apprehension of cosmic wisdom; science renders phenomena meaningful. Discovery is the moment of insight, eventually yielding a testable hypothesis. Justification is an odd word: originally it was a theological term (as for example in Pauline “justification through faith”). But it is the proper term for the testing of a scientific hypothesis.

Now this prevailing model is beset with difficulties. For example, there is no method for discovery; it is treated as extra-scientific. Science is viewed as beginning with the testing of a hypothesis; as the great biologist Peter Medawar put it, hypothesis formation is a “logically unscripted” moment. Another related problem is the reduction of intelligibility to rational reconstruction (what David Bohm calls “axiomatization”)¹: we want to reduce our

intuitions too quickly to mathematical axioms, and indeed have come to see the axioms as primary, whereas they are properly derivative from insight. This leads to the hypertrophy of justification (David Bohm again) at the expense of intelligibility. Moreover, as Thomas Kuhn has demonstrated so brilliantly, scientific practice does not conform to the methodological stereotype of falsification.² “Normal science” tries furiously to explain everything in light of the prevailing paradigm, even though it is only falsification that yields scientifically valid (if negative) insights. There have been notable failures of replication, especially recently: in one egregious case, researchers at the University of Virginia were able to replicate only 39 out of 100 central experiments in the field of psychology. And truth as “conformity to appearances” has been undermined by the psychology of perception: there is no “neutral observation language,” as for example in Jerome Bruner’s discovery of “perceptual readiness”; we see what habit accustoms us to

1 David Bohm, “Imagination, Fancy, Insight, and Reason in the Process of Thought,” in Shirley Sugerman, ed., *Evolution of Consciousness: Studies in*

Polarity (Middletown, CT: Wesleyan UP, 1976), pp. 51-68.

2 Thomas Kuhn, *The Structure of Scientific Revolutions, 50th Anniversary Edition* (Chicago: U of Chicago P, 2012).

seeing, rather than what's actually there.

Much more could be adduced here, but this much already makes clear that something different is needed. So let's expand the discussion by bringing in three additional concepts: sublimity, beauty, and elegance.

Sublimity is not a standard scientific category; I propose it as such. Archetypally sublime experiences have been the Alps, a storm at sea, and, in Kant, the mathematical concept of the infinite. The sublime awakens wonder in the cognitive sense, and awe in the aesthetic and moral senses. Hence the famous quote from the end of Kant's *Critique of Pure Reason* (1781): "Two things fill the soul with ever-renewed and ever-growing admiration, the more frequently and constantly reflection applies itself to them: the starry sky above me and the moral law within." Buckminster Fuller saw Einstein's Theory of Relativity as "the metaphysical mastering the physical," which again would be a manifestation of the sublime. The sublime is not a standard scientific concept, but it should be.

Beauty, however, is very much a standard scientific category! Beauty is about harmony in all its guises, and especially about the harmony between parts and wholes. Hence Kant approached aesthetic and biological forms with the same concepts in his *Critique of Judgment* or *Third Critique* of 1790, and inspired Schiller's *Essay on Aesthetic Education* (1794), which inspired Steiner in turn. Kant, Schiller, and Steiner view beauty as a direct manifestation of moral ideas. Beauty hovers between sublimity and elegance: you feel awe at seeing hitherto unapprehended connections (tending to the sublime), and you sense unity captured within multiplicity (tending toward elegance).

Over and over we hear of the centrality of beauty to great science. For example, James W. McAllister quotes the physicist Paul Dirac: "When Einstein was building up his theory of gravitation he was not trying to account for some results of observations. Far from it. His entire procedure was to search for a beautiful theory ... The real foundations come from the great beauty of the theory ... It is the essential beauty of the theory which I feel is the real reason for believing in it."³ Or S. Chandrasekhar quoting Hermann Weyl: "My work has always tried to unite the true with the beautiful; but when I had to choose one or the other, I usually chose the beautiful."⁴ "So far, no predictions of general relativity, in the limit

of strong gravitational fields, have received any confirmation; and none seem likely in the near future," writes Chandrasekhar, but according to Paul Dirac, "What makes the theory [of general relativity] so acceptable to physicists ... is its great mathematical beauty" (148). "If you listen to scientists talking, or read what they write outside of peer-reviewed articles, then a very different picture emerges," writes David Orrell;⁵ "there is a general acceptance that beauty and truth are mysteriously and inextricably linked. Indeed, the central drive of science often seems to be as much a quest for beauty as for truth, on the understanding that the two are to be found at the same place...the rallying cry of fundamental physicists is, 'Let us worry about beauty first, the truth will take care of itself!'" In his important study *The Copernican Revolution*, Thomas Kuhn boldly claimed that the reason for the shift from the Ptolemaic to the Copernican paradigm was primarily *aesthetic*: "... in the absence of increased economy or precision, what reasons were there for transposing the earth and the sun? ... as Copernicus himself recognized, the real appeal of sun-centered astronomy was aesthetic rather than pragmatic ... as the Copernican Revolution itself indicates, matters of taste are not negligible. The ear equipped to discern geometric harmony could detect a new neatness and coherence in the sun-centered astronomy of Copernicus, and if that neatness and coherence had not been recognized, there might have been no revolution."⁶

At regular intervals, various mathematical and physical societies poll their memberships, asking: What is the most beautiful mathematical formula of all time? And there is always a clear winner: Euler's Identity. (Leonhard Euler, who lived from 1707 to 1783, was the Mozart of mathematicians; great mathematics streamed through him effortlessly.) It runs as follows:

$$e^{i\pi} + 1 = 0$$

And indeed, it is a gorgeous formula, rich and strange for all its brevity. Every aspect of mathematics is represented in archetypal form: you have the constant of analysis, "e," and hence calculus; the unit imaginary number, "i"; a geometrical constant, "π," which is arguably the first irrational number; the first natural number, "1" (which is also the identity principle for multiplication); and the first integer, "0" (which is the identity principle for addition).

3 James W. McAllister, *Beauty and Revolution in Science* (Ithaca: Cornell UP, 1999), pp. 15-16.

4 S. Chandrasekhar, *Truth and Beauty: Aesthetics and Motivations in Science* (Chicago: U of Chicago P, 1987), p. 65.

5 David Orrell, *Truth or Beauty: Science and the Quest for Order* (Oxford: Oxford UP, 2012), pp. 3-4.

6 Thomas Kuhn, *The Copernican Revolution* (Cambridge: Harvard UP, 1957), p. 171.

tion). You have the all-important operations of addition and equality. But it is also strange: what to make, for example, of “ π ” as an exponent? And what does it mean? Benjamin Pierce, who was a professor of mathematics at Harvard University and the first American mathematician to achieve international prominence, said of Euler’s Identity: “Gentlemen, that is surely true, it is absolutely paradoxical; we cannot understand it, and we don’t know what it means. But we have proved it, and therefore we know it must be the truth.” Note that we needn’t understand an insight fully (yet) in order to recognize it as scientific—indeed as great science. This contention is potentially very consequential for anthroposophy.

It is extremely revealing if we make a simple algebraic transformation of the formula, rendering it more elegant:

$$e^{i\pi} = -1$$

The result is more elegant, but far less beautiful. Truly a Goethean *Urphänomen*!

In his splendid study *The Emperor’s New Mind*, Roger Penrose quotes from Jacques Hadamard’s *Psychology of Invention the Mathematical Field*: “But with [the great French mathematician Henri] Poincaré we see something else, the intervention of the sense of beauty playing its part as an indispensable means of finding ... this choice is imperatively governed by the sense of scientific beauty.”⁷ And Penrose himself adds: “... aesthetic criteria are enormously valuable in forming our judgements ... the strong conviction of the validity of a flash of inspiration ... is very closely bound up with its aesthetic qualities. A beautiful idea has a much greater chance of being a correct idea than an ugly one” (421).

If we look up “mathematical beauty” on *Wikipedia*, we find that a beautiful proof “derives a result in a surprising way”; that it “relates the apparently unrelated,” and that it yields “new and original insights.” But notice that these are all consonant not with justification, but with discovery! This is an all-important insight. Results that are both novel in these ways and especially fundamental and encompassing are called “deep.” Moreover, in *Poetic Diction*, Owen Barfield argues that beauty in literary language is what calls forth “a felt change of consciousness.”⁸ Likewise, Penrose argues that mathematical truth is not something that we ascertain merely by use of an algorithm. “I believe, also, that our consciousness is a crucial

ingredient in our comprehension of mathematical truth. We must ‘see’ the truth of a mathematical argument to be convinced of its validity. This ‘seeing’ is the very essence of consciousness” (418). It follows that science is fundamentally about the expansion of human consciousness.

We have arrived at a key contention and a key question regarding beauty in science. My contention is that beauty is to discovery as rigor is to justification. Hence, *beauty is the rigor of discovery*. The fundamental scientific value of symmetry, for example, is first and foremost an *aesthetic* criterion. We treasure the embedded rigor that has led to an elegant formulation, but I am moved to ask: Is the elegant really more rigorous than the beautiful?

We associate the notion of elegance, or parsimony, with William of Ockham (ca. 1287-1347). “Occam’s razor” (as it’s called) asserts that “With all things being equal, the simplest explanation tends to be the right one.” Let’s explore the role of elegance in the history of astronomy.

Retrograde loop of Mars (time lapse)



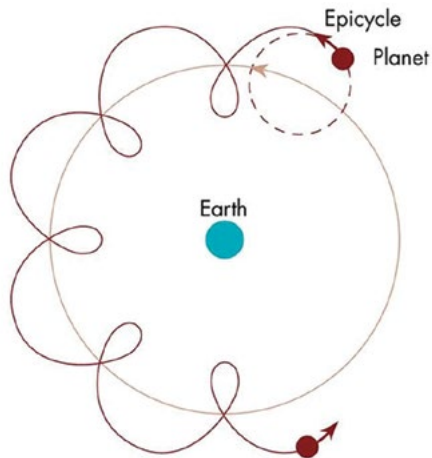
In his study *The Ballet of the Planets*, Donald C. Benson insists on the centrality of “elegance” in multiple passages⁹: “Science prefers theories of the greatest possible generality and simplicity.” (xiii); “the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience” (3); “the world is simpler than it seems, and every effort should be made to discover its simplicity” (4); [Occam’s razor quoted directly] (6); and [the heliocentric frame of reference] “contains no curves that are more complex than circles” (36). Above all things, he claims, astronomical theory should strive for elegance.

Thus we want to be rid of the deferents and epicycles of the Ptolemaic model (*image next page*).

7 Roger Penrose, *The Emperor’s New Mind: Concerning Computers, Minds, and the Laws of Physics* (Oxford: Oxford UP, 1989), p. 421.

8 Owen Barfield, *Poetic Diction: A Study in Meaning* (London: Faber and Faber, 1962), p. 48.

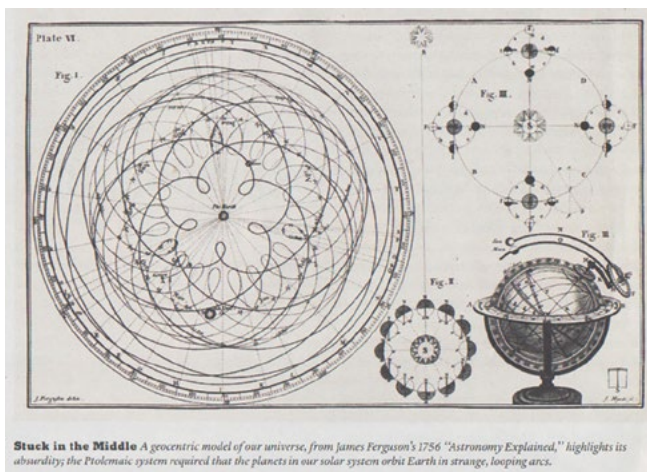
9 Donald C. Benson, *The Ballet of the Planets: On the Mathematical Elegance of Planetary Motion* (Oxford: Oxford UP, 2012).



However, it is not *wrong* to do so; merely unaesthetic: “The motions of the planets can be described fully in either of these frames of reference [geocentric or heliocentric], but eventually it was discovered that the heliocentric frame of reference has the advantage of greater simplicity” (36). He states very clearly that “there is no logical flaw regarding either Earth or the Sun as motionless and charting the motion of the rest of the solar system accordingly” (35), and “The geocentric view is not incorrect—merely unduly complicated” (48). The heliocentric theory is preferred merely because the geocentric model is more complicated without compensating benefits (38).

But elegance can cast deep shadows. It is a short step from parsimony to reductionism, leading to loss of intelligibility. Meaning can be sacrificed to “efficiency”; parsimony can be a prelude to control and manipulation of nature. Hence Steiner fundamentally questions parsimony as an explanatory ideal.

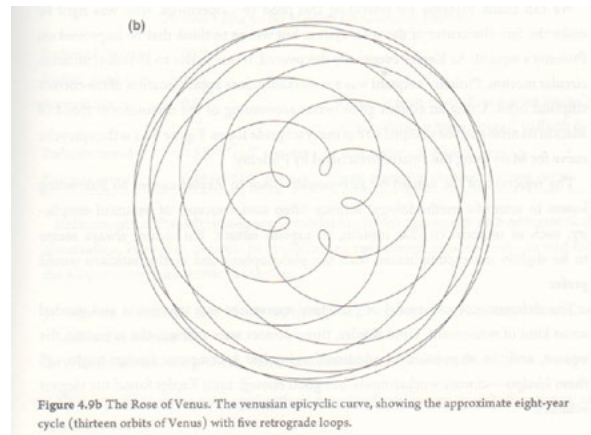
The following rather comical illustration was printed in the *New York Times* on January 11, 2015:



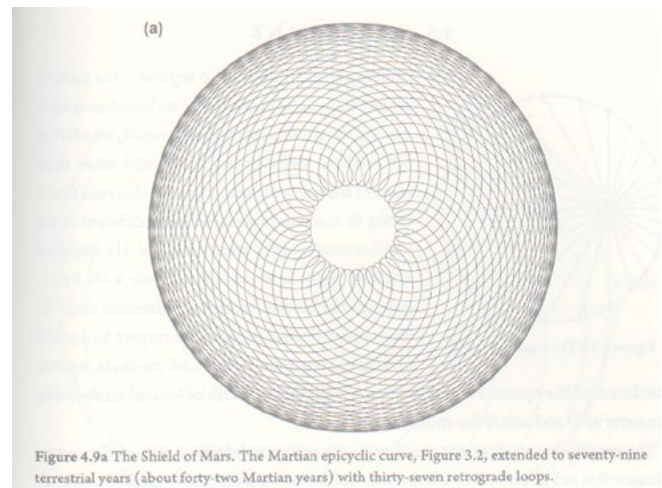
Note the caption: the “strange, looping arcs” of the geocentric model are “absurd.” Can the author really have

failed to see their beauty?

Let’s isolate the paths of the planets. If one allows Venus to run its full cycle (approximately eight years), the result is the intensely beautiful “Rose of Venus”:



Mars is even more striking. Allowed to run its full course (about 79 years), the result is the stunning “Shield of Mars”:

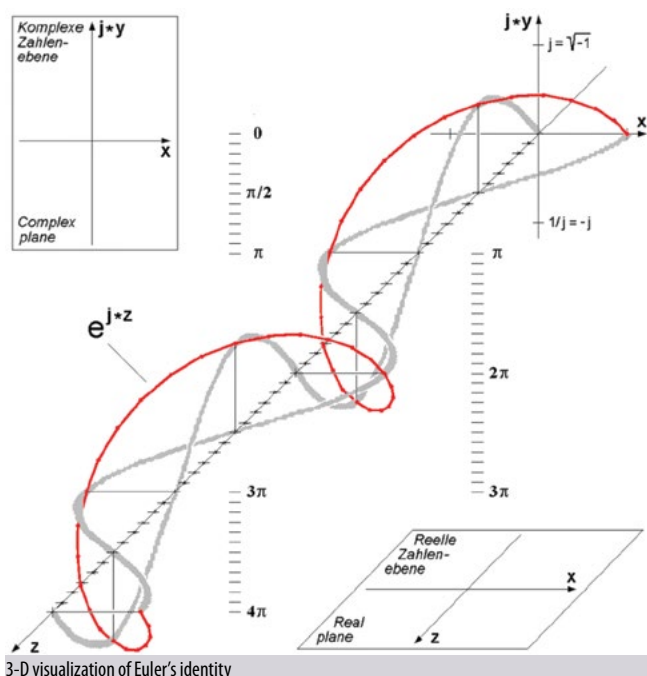


There is a “compensating benefit”: the extreme beauty of the phenomena, which is integral to their intelligibility.

By the way, a 3-D visualization of Euler’s identity¹⁰ generates beautiful retrograde loops! (*Image next column.*)

An early account by Rudolf Steiner of karma as a form of memory is one example (of many that could be adduced) of a beautiful symmetry in anthroposophy. We have experiences, as a result of which we form personal memories, which change in turn the way we act upon the world. So much is straightforward. But one needs to imagine a similar process on the other side: as a result of our actions, a supra-personal memory is formed, and that changes the way the world acts upon us. Biographical

¹⁰ The image is from *Wikipedia*.



events—in short, our karma—are anything but random. They are the world remembering our past deeds and acting accordingly. The result is an elegant and symmetrical theory of the spirit as *the unconscious of nature + cosmic memory*.

Anthroposophy can also be very sublime. Take, for example, the workings of karma viewed from an evolutionary perspective: “According to Steiner, we typically alternate gender, and move from culture to culture across many incarnations, absorbing (or at least being given the chance to absorb) the best that each culture has to offer. It is a deeply cosmopolitan vision: all of us, over time, wittingly or not, are gradually becoming citizens of the world and whole human beings.”¹¹ Such a view sends shivers down the spine.

Now we’re ready to answer the question: “What’s scientific about spiritual science?” *Anthroposophy is scientific because it is pervasively beautiful and deep*. It fits all the criteria for mathematical and scientific beauty that we elaborated already: it’s “surprising,” it “relates the apparently unrelated,” and it yields “new and original insights.” It also fits Roger Penrose’s description of scientific discovery as a “felt change of consciousness.”

But I would go even further. Unlike mainstream science, anthroposophy has developed and described *a rigorous method for calling forth and controlling such changes of consciousness*. Hence, anthroposophy *fills a great lacuna in*

scientific method by providing a *methodology of discovery*.

Above all, anthroposophy avoids reductionism—false elegance to the end of control—in order to maximize the neglected dimension of intelligibility, or meaning. Anthroposophy is the Shield of Mars and the Rose of Venus—dazzlingly beautiful, dripping with meaning, “adventure” in Whitehead’s sense!

But if anthroposophy is scientific, even deeply scientific, why does it appear unscientific to so many people on first encounter?

My own answers are: (1) anthroposophy is sometimes sublime, it’s almost always beautiful, *but it’s rarely elegant* in the positive sense of that term. And (2) anthroposophy as delivered is *pure discovery*, unaxiomatized. It’s because discovery is so rare in conventional science that we don’t recognize it when we see it.

So if anthroposophy is all about discovery, why isn’t it just metaphysics? Or, to put the question another way, does anthroposophy have a problem with “justification”? First, we should recall that justification has become problematical within mainstream science, which often falls short, despite its claims. So there are challenges here on both sides. Chiefly, however, I contend that anthroposophy *does* “justify” itself, and in the best possible way: anthroposophy justifies itself *outside the text* through *practical application*. And this distinguishes anthroposophy from most other spiritual disciplines.

Anthroposophy *as delivered* was scientific, but it is scientific *for us* only if we *work with it scientifically*. Barfield writes in *Poetic Diction* that at the highest level, there’s no distinction between art and science; there’s only a distinction between “bad art” and “bad science” (139). In the same vein, I contend that the only real distinction is between “bad anthroposophy” and “bad science”—i.e., there is a distinction only when both have ceased to be processes of discovery.

There remain some residual questions regarding elegance. Should we care that anthroposophy is seldom elegant in the positive sense? Can anthroposophy be made more elegant? Is it perhaps our job to make anthroposophy more elegant? Should we try? My own provisional answer to all four questions is: yes.

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11 Frederick Amrine, “Discovering a Genius: Rudolf Steiner after 150 Years,” *being human*, 1 (2011) 13-14.