NEOPLATONISM IN SCIENCE PAST AND FUTURE

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I. Introduction

In this article I argue that modern Neoplatonism can contribute to a revitalization of science and an improved human relationship to nature. I begin by considering the role of Neoplatonism in the history of science, considering both ideas that have contributed to the constitution of contemporary science, and those that have been abandoned by it. Then I mention two especially Pythagorean developments in contemporary science. Finally, I turn to the future, to the contributions that I believe Neoplatonic ideas can make toward the future of science.

II. The Past

Recall the alternative views of nature and science that competed in Europe in the 16th and 17th centuries.[1] We may take as our starting point the Aristotelian-Thomistic cosmology, which resulted from Aquinas' rehabilitation and Christianization of Aristotelian cosmology and Ptolemaic astronomy, and which dominated European thinking from the thirteenth century. A value system was implicit in this cosmology, which placed a stationary Earth at the center of the universe, in the center of which was Hell and the Devil (Easlea 1980, pp. 43, 57–8). In polar opposition was God in His heaven, the active force outside the circumference of the Primum Mobile. Correlated with this polarity of good and evil were other oppositions, many of which can be found in the Pythagorean Table of Opposites: form / matter, mind / body, active / passive, male / female, heaven / earth, and so forth (Easlea 1980, pp. 46–50). The causes of these associations and correspondences are complex and not entirely cultural, for they also have psychological and biological roots, but that is beyond the scope of this article (Hillman 1978,

[1]. In this brief overview I am indebted to the work of Brian Easlea (1980) and especially to the classic works by D. P. Walker (1958) and Frances Yates (1964, 1966). The primary sources are very numerous, but the citations may be found in these works.

Pt. III; Stevens 1998, pp. 116–23).

As the weaknesses of the Thomistic-Aristotelian philosophy became apparent, two philosophical orientations presented themselves as the chief contenders for a new philosophy of nature (Easlea 1980, pp. 89–90). On one hand was the *mechanical philosophy*, as developed especially by Gassendi and Descartes, and on the other was the (so-called) *magical philosophy*, which was advocated in one form or another by Neoplatonists, alchemists, Hermeticists, adherents of the supposed *prisca theologia*, and so forth. A principal difference between the two was their view of nature. In accord with Cartesian dualism, the mechanical philosophers viewed non-human nature as inanimate and sought to understand natural processes in terms of mechanical principles, such as shape, position, and motion, rather than in terms of sensory qualities, which were considered fundamentally illusory. On the other hand, in general accord with Neoplatonic cosmology (stemming ultimately from the *Timaeus*), the magical philosophers understood nature in terms of an *anima mundi*, which vitalizes and governs the material world (Merchant 1980, ch. 4). One consequence of these differences was that mechanical philosophers were stronger advocates of using mechanistic principles to appropriate and exploit non-human nature for human benefit, a foundation of the industrial revolution (Easlea 1980, ch. 5). The magical philosophy, however, entailed a degree of reverence for Nature and implied circumspection in possessing and exploiting "her" (Easlea 1980, pp. 102–4, 111–12, 139). Against this background I will mention some Neoplatonic ideas that were either adopted or abandoned by modern science as it emerged at this time.

As is well known, discussion of the *Corpus Hermeticum* by Lactantius (*Div. Inst.*, I.vi, *De ira Dei*, XI) led to the impression that these texts were of enormous antiquity, that Hermes Trismegistus was a contemporary of Moses, and that the Hermetic tracts represented the *prisca theologia*, the primordial theology revealed by God. This misperception persisted until corrected in 1614 by the textual analysis of Isaac Casaubon. In the interim, the texts' apparent antiquity and the respect accorded them by Lactantius lent them considerable credibility. In particular, acceptance of the *philosophically* oriented *Hermetica* encouraged acceptance of the more overtly *magical* tracts. Thus we have

the roots of Renaissance Hermeticism.

Although the *Hermetica* are not homogeneous, they are broadly in agreement with Neoplatonic theory and practice (e.g., Fowden 1986, pp. 188–95), and so Marsilio Ficino and his followers found little difficulty in crafting a Hermetic philosophy, which they considered to be consistent with Christianity (Yates 1964, ch. VI). It is the theoretical and practical core of the magical philosophy, but let us consider its relation to modern science.

Aside from its scientific impact, the eventual shift to a heliocentric cosmology was a development of enormous symbolic significance. The astronomical reasons for this change are familiar, but it is important not to forget the philosophical background. The Central Fire—often misinterpreted as the Central Sun—was an idea inherited from ancient Pythagoreanism, and Copernicus called his heliocentric model "the Pythagorean theory" and quoted the *Hermetica* in its defense (*De revol. orb. cael.*, Thorn ed., 1873, p. 30; Yates 1964, p. 154). Heliocentrism was motivated as much by religious and philosophical considerations as by astronomical ones, for Neoplatonism, Hermeticism, and related philosophies considered the Sun to be "the visible god," associated with the Demiurge, and a potent symbol for the One and its power, irradiating the material world and bringing it life (Yates 1964, pp. 153–4). From this perspective, the Sun *belonged* in the center of the universe, which thereby became the fountainhead of the Good rather than the central abyss. Giordano Bruno, in his defense of Copernicanism, referred back to the solar magic of Ficino's book *De vita coelitus comparanda*, his most overtly magical work.[2] Consistently with the heliocentric view, Bruno (*Ash Wed. Supper*, Dial. I, p. 61) argued that the Earth, "our perpetual nurse and mother," as he called her, *must* move because she is alive and eternal by virtue of her continual self-renewal. It was a tenet of the magical philosophy, which we find for example in Cornelius Agrippa (1651/1993, II.56), that the stars and planets are sources of vitality and motion, and therefore that they have souls and are alive themselves (Yates 1964, p. 243). Similarly Kepler, who was influenced by Agrippa, the Paracelsans, Proclus, and other Neoplatonists, said the earth is a living being with an *anima terrae* structured like

[2]. Yates (1964, pp. 155, 208–9). See Ficino (1998, Bk. III) for *De vit. coel. comp*.

the *anima hominis* (Pauli 1955, pp. 156–77).

Qabalah, in the form in which it emerged in the Middle Ages, incorporated many Neopythagorean ideas, especially in its decad of *Sephiroth* or divine emanations (Yates 1964, pp. 92–3).[3] Indeed, Scholem (1965, p. 167) has argued that the *Sefer Yezirah*, a principal Qabalistic text, was written by a Jewish Neopythagorean, perhaps in the first centuries CE. The other principal text, the *Zohar*, was written in Spain in the thirteenth century, where Ramon Lull was active (Yates 1966, p. 178). Significantly influenced by the Neoplatonic systems of pseudo-Dionysius and John Scotus Erigena (Yates 1966, pp. 177–8), as well as by the Qabalah, Lull is best known for his system of rotating wheels labeled with letters corresponding to the dignities of God, which are, in effect, simultaneously the divine names of pseudo-Dionysius and the Sephiroth of the Qabalah (Yates 1966, pp. 178–9). To put it in other terms, we have in the Lullian art a system of archetypal ideas, whose interrelationships can be explored combinatorially by rotating the wheels (Yates 1966, p. 178).

It is significant, as Yates has stressed, that in Lull's art these archetypal ideas were represented by letters, not by the symbolically rich images used in prior systems for organizing ideas, such as the magical memory systems of Bruno and Campanella (Yates 1966, pp. 176–7). In this, Lull is connecting with Qabalistic interpretation of the letters of the Hebrew alphabet as the atomic constituents, as it were, of the Name of God, and with the Qabalistic practice of *gematria*, by which hidden correspondences and connections between ideas were found by means of the numerical values of the Hebrew letters, and with Neopythagorean use of the numerical values of the Greek letters for numerological speculation (Yates 1964, p. 92; 1966, pp. 178–9). Although these practices are found primarily in Gnosticism, they were commonly attributed to the ancient Pythagoreans (e.g., Hippolytus, *Refutatio*, 6.25, 6.47, 7.14, 8.5-8).

Another important aspect of Lull's art, as Yates (1966, p. 178) emphasizes, is that it was intended as a *method* for discovering and

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[3]. A good example of Neopythagorean treatment of the decad is pseudo-Iamblichus' *Theologumena arithmeticae* (ed. de Falco, 1922; tr. Waterfield as *The Theology of Arithmetic*, Phanes, 1988).

demonstrating truths, specifically the truths of Christianity. The symbolical and mystical meanings of Lull's characters were closely tied to his medieval world-view, but in the seventeenth century, several philosophers were inspired to improve on his idea and to apply it to the discovery, codification, and demonstration of scientific knowledge.[4] Chief among these was Leibniz, who was deeply influenced by Lull, Bruno, Qabalah, alchemy, and Hermetic philosophy with a Rosicrucian accent.[5] According to Yates (1966, p. 370), he defined his project as:

> a general science, a new logic, a new method, an *Ars reminiscendi* or Mnemonica, an *Ars Characteristica* or Symbolica, an *Ars Combinatoria* or Lulliana, a Cabala of the Wise, a Magia Naturalis, in short all sciences will be here contained as in an Ocean.

There is a direct line of descent from the ideas of Leibniz and his contemporaries for formal knowledge-representation languages and mechanized reasoning, through the development of symbolic logic and formalized mathematics, to the computational models of knowledge and cognition used in artificial intelligence and cognitive science, but that is outside the scope of this paper. It suffices here to observe that the Lullian vision affected the pursuit of *method*, which occupied many seventeenth-century philosophers, including Descartes, Bacon, and Leibniz, for this pursuit was redirected toward a methodology of abstract relationships among monadic ideas (Ong 1958; Yates 1966, ch. 17; Rossi 2000, ch. 5). Although this drive reached its apex in the logical positivist philosophy of the early twentieth century, it still survives in the preference for mathematical abstraction in all scientific theories.

It is interesting to recall that contemporary with the Lullian art, there were other systems for organizing ideas, dating to classical antiquity, used for memory, spiritual contemplation, or magic, which (in contrast to Lull's art) made use of symbolically rich images rather than abstract characters (Bolzoni 2001; Carruthers & Ziolkowski 2002; Yates 1966; Rossi 2000). These systems also had roots in Neoplatonism, and had applications in religion, alchemy, and other spiritual disci-

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[4]. Yates (1966, ch. 17, esp. pp. 356–7, 361–2, 364–5); see also Ong (1958) and Rossi (2000).

[5]. Yates (1966, pp. 367, 372–3). For more, see Coudert (1995) and Rossi (2000).

plines. They arose from a confluence between the ancient art of memory, attributed to Simonides of Ceos, and the Platonic explanation of knowledge as recollection. The art of memory, as known primarily through the *Ad Herennium*, recommended placing vivid, active symbolic images for ideas (*imagines agentes*) in distinct spatially-organized visualizable places (*loci*), so that their relationships could be recalled (Yates 1966, ch. 1). Platonic epistemology, in comparison, understood the Forms or Ideas to have an eternal structure and fixed relationships.

Already in the Pythagorean revival of late antiquity memory was connected with spiritual practices, and biographers attributed a prodigious memory to such figures as Pythagoras and Apollonius of Tyana (Yates 1966, p. 56). Also beginning in antiquity was the use of cosmologically significant structures, such as the zodiac, decans, and planetary spheres, to organize ideas and their images (Yates 1966, p. 54). In this way the art of memory allowed the macrocosm to be reflected in the microcosm of the individual mind.

In the Middle Ages there was increasing use of the art of memory to internalize religiously significant ideas, such as the articles of faith, the virtues and vices, and the paths to salvation and damnation (Yates 1966, pp.67–9). (Recall also the *Tablet of Cebes*, named for a famous Pythagorean and described as a dedication of a follower of the Pythagorean and Parmenidean way of life.) Albertus Magnus said that the images of the virtues, for example, contained their own *intentiones*, which were efficacious for imparting the virtues (Yates 1966, p. 76). Further, Aquinas introduced a devotional focus into the art of memory by suggesting that the images should be contemplated with solicitude and affection (Yates 1966, pp. 83–7). (Contributing to this development was the medieval practice of *Ars Notaria*, a magical art of memory, attributed to Pythagoras, in which one sought illumination by contemplating esoteric figures while reciting magical prayers; Yates 1966, pp. 56–7.)

In the Renaissance these developments reached their culmination in the spiritual magic of Ficino and Pico, who took practices from the *Asclepius* and other *Hermetica* for the "ensouling" (ἐμψύχωσις, *animatio*) of images, and synthesized them with the art of memory, the astral magic of the *Picatrix*, and the Neoplatonic theurgy of Iamblichus

and Proclus. In this art properly structured memory images were regarded as "inner talismans," which through their theurgic power could draw down celestial influences and unite the divine part of the human mind with the divine powers of the cosmos (Yates 1966, pp. 149–62).

However, these symbolically rich images did not lend themselves so well to the newborn mechanical philosophy, with its emphasis on quantifiable size, shape, and motion in preference to phenomenological qualities (Yates 1966, pp. 360–5). Indeed, the imagistic systems were more suited to expressing psychological structures than physical relationships, and so they have been used, especially by Jungian psychologists (von Franz 1974, chs. 10, 11; Jung 1969a, chs. XIII, XIV). In summary we may say that the new science took up the more formal, logical, and abstract aspects of Neoplatonism, but left the more concrete, imaginative, and symbolic aspects to the magi and their successors.

Another aspect of Neoplatonic philosophy that influenced the new science was the idea that there are hidden causes behind the phenomena of the sensible world. That is, all change in the phenomenal world is an effect of an eternal structure of abstract ideas. Thus the reality we ordinarily experience is not the true, or most fundamental reality; it is rather an image, shadow, or reflection, in fact, an illusion. True reality is an immaterial abstract structure, imperceptible to our senses, accessible only through reason and indirect experimentation.

This reductionist perspective is already apparent in Newton's explanation of color as wavelength. His division, on the basis of wavelength, of the continuous spectrum into seven colors, explicitly analogized with the seven tones of the diatonic scale, is just one example of Newton's intentionally Pythagorean approach, in which the hidden *quantities* are real, and the manifest *qualities*, illusions (Bortoft 1996, pp. 38–40, 192–212; Gage 1993, ch. 13, esp. p. 232). Indeed, the reduction of experiential qualities to imperceptible quantities has been typical in physics ever since the development of atomic theory. However, modern science understands the hidden causes to be abstract and mathematical, whereas Neoplatonism and the magical philosophy understood them to be living, psychical, and divine actions of the World Soul (a contrast already apparent in the Kepler-Fludd controversy; see Yates

1964, pp. 440–4; Pauli 1955).

The Renaissance magi understood that different material objects might be irradiated by the same archetypal idea, and that this hidden connection was the cause of sympathies and antipathies between material objects (Easlea 1980, pp. 92–4). The doctrine of cosmic sympathy originated with the Stoics (Wallis 1972, pp. 70–1, 110), but the Neoplatonists adopted it, and Agrippa, for example, cites Iamblichus, Proclus, and "the Platonists" as authorities on "occult virtues" (e.g., Agrippa 1651/1993, I.22, 38, III.59; 1694, ch. 44).

Although the notion that there might be occult affinities between objects was anathema to the mechanical philosophers, it was essential to the theory of gravity. Newton protested *hypotheses non fingo*, but his acceptance of occult forces no doubt facilitated his mathematical description of gravitational force in the absence of mechanical interactions (Easlea 1980, pp. 90, 111, 164–83); in fact, he thought Pythagoras had already discovered the inverse-square law by means of his harmonic theory (White 1997, pp. 348–9). As a closet alchemist and Hermetic philosopher, Newton believed that universal gravity demonstrated the active presence of God in the world, whereas the mechanical philosophers generally believed that God had left the physical world alone since the end of the Age of Miracles (Easlea 1980, pp. 22, 182).

However, due to the hidden nature of the causes, these sympathetic relations were difficult to determine by reason alone (Easlea 1980, p. 93). Therefore, practicing magi, such as Paracelsus, that is, those who, among other things, were actually trying to cure the physical and mental ills of humankind, were forced to resort to experiment to discover the occult sympathies in the material world (Easlea 1980, pp. 100–3; see also Webster, 1982). As the limitations of a purely rationalistic approach to the mechanical philosophy became apparent, some philosophers, such as Francis Bacon and Robert Boyle, began to adopt these empirical methods (Easlea 1980, pp. 90, 126–9, 194–5, 202). Boyle, of course, had been an alchemist and Hermetic philosopher with Rosicrucian sympathies (Easlea 1980, pp. 136–9). However, he abandoned, along with his Hermetic ideas, the notion that the natural world is divine, saying (*Inq. Vulg. Rec. Notion Nature*), "the veneration, wherewith men are imbued for what they call Nature, has been a dis-

couraging impediment to the empire of man over the inferior creatures of God" (Easlea 1980, p. 139). Thus he enunciated an attitude that has contributed to our environmental crisis.

Similarly Bacon, with metaphors that would have warmed the cockles of Freud's heart, enthused that the experimental method would allow men to "penetrate further," through "the outer courts of nature," to "find a way at length into her inner chamber," in order to find the "secrets still locked in Nature's bosom" (Easlea 1980, p. 129). By the "trials and vexations" of experiment, Nature would be put on the rack and compelled to answer (Easlea 1980, p. 128). Nature and all her children would be men's slaves, Bacon promised (Easlea 1980, p. 129). Nor was he alone. Many of the adherents of the new "Masculine Philosophy" (as they called it) saw Dame Nature as a subject of torture, domination, and exploitation (Easlea 1980, pp. 128–9, 213–14, 236, 241–52). Surely it is not coincidental that these remarks were made during the culmination of the witchcraze (see also Merchant 1980).

Of course, like the mechanical philosophers, the magical philosophers were also interested in practical results, but their understanding of nature as having a soul and being divine led them to take a more cooperative and less dominating stance toward her (Easlea 1980, pp. 94, 103, 112). Also, the magical philosophers understood themselves to be a part of this same nature, a unified emanation of the One, whereas Descartes had taught the mechanical philosophers that human souls were essentially separate from a soulless nonhuman world. So also, the magical philosophers understood themselves as *participants* in nature (Yates 1964, pp. 31–2), whereas the mechanical philosophers took the stance of *observers* separate from the object of their observation, a view that has interfered with scientific understanding in areas as disparate as quantum mechanics, ecology, psychology, and sociology.

Against the development of modern science, I must mention a notable dissenting voice.[6] Goethe's well-known campaign against Newtonian science (Sepper 1988) was rooted in a different conception of

[6]. Goethe (1988) includes some of Goethe's most important writings on the philosophy of science, whereas Goethe (1996) has shorter, often aphoristic, extracts; the commentary in both collections is useful. Bortoft (1996) analyzes Goethe's philosophy of science from a phenomenological perspective. Seamon & Zajonc (1998) collect recent articles on Goethean science.

the proper role of science in human life (Heisenberg 1974b). His view has much in common with Neoplatonic and Hermetic philosophy, which is not unexpected since he was influenced by Neoplatonic ideas, by alchemy, by Boehmist mysticism, and so forth (Gray 1952, Pt. I; Raphael 1965, Pt. I).[7] Whereas modern science can be characterized as *analytic*, *observational*, and *reductive*, Goethe's approach is *empathetic*, *participatory*, and *holistic* (Barnes 2000; Bortoft 1996, pp. 3–26, 49–76, 321–30; Goethe 1995, pp. 12, 22, 28, 41, 48; Pauli 1955, pp. 205–6). In essence it recognizes our kinship with the rest of the natural world, and accesses the universal archetypes within our minds to facilitate our assimilation to, and our empathetic understanding of, nature (Bortoft 1996; Goethe 1995, pp. 22–4, 103–109). In more Platonic terms, "like knows like" and intuitive understanding comes with participation in the *energeia* of the archetypal forms. Let me explain.

Goethe's scientific methodology is essentially phenomenological (Barnes 2000; Bortoft 1996; Goethe 1995, p. 11; Seamon 1978; Seamon & Zajonc 1998). First, it focuses on the qualities of things as experienced by the whole person, that is, by the senses, emotions, reason, intuition, and all the other faculties of the observer, rather than on abstract quantities hypothesized to lie behind an effectively illusory sensory world (Bortoft 1996, II.4, III.3–4; Goethe 1995, pp. 9–11, 17–20, 28–30, 36, 64; Heisenberg 1974b). Thus we may contrast Newton's theory of color, which reduces it to a single quantity, wavelength, with Goethe's, which embraces the full range of color phenomena, such as experienced by a painter, poet, or sensitive naturalist (Bortoft 1996, II.2, III.4; Goethe 1995, p. 18; Pauli 1955, p. 206). But Goethe is emphatic that his approach is not subjective (Bortoft 1996, p. 34–5; Goethe 1995, pp. 34, 37–8). Rather, by sensitive observation of, experimentation with, and participation in nature, the mind of the naturalist achieves a kind of harmony, or empathetic attunment, with natural phenomena (Goethe 1995, pp. 11–12, 24, 33, 48).[8] Understanding arises

[7]. Goethe was more directly influenced by alchemy and Hermeticism than by Neoplatonism, but he claimed the latter was the foundation of his religious beliefs and that he had read the *Enneads* by the time he was fifteen; later he studied Iamblichus and Bruno (Gray 1952, pp. 49–50, 105).

[8]. Pauli (1955, pp. 205–6) compares Goethe's criticism of Newton to Fludd's criticism of Kepler. In both cases the former has an intuitive-feeling personality with a holistic

from a coincidence of inner form and outer fact. That is, the mind of the Goethean scientist participates in the same archetypal idea—which Goethe called the *Urphänomen*—as does the natural process (Bortoft 1996, pp. 22–3, Pt. III, ch. 5; Goethe 1995, ch. 7; Heisenberg 1974b). Like knows like.

Goethean science has been described as both Platonic and anti-Platonic (Bortoft 1996, III.5; Dieckmann 1972, p. 8; Goethe 1996, pp. 11–12; Heisenberg 1974b), a paradox that can be explained as follows. On the one hand, Goethean science stays focused on direct experience of nature, and seeks to understand natural phenomena in themselves, eschewing theories couched in terms of hidden realities supposed to be the ultimate causes of the visible world. Understanding is rooted in sensory experience, and in this sense it can be described as anti-Platonic. On the other hand, by seeking the *Urphänomene*, Goethean science is directed toward discovering the objective archetypal ideas that simultaneously structure nature and our possible experience and understanding of it. Therefore, these objectively existing archetypal ideas organize existence and are the foundation of any understanding of being, and so in this sense Goethean science is Platonic, for the archetypal ideas define the sensory world. Indeed Nisbet (2002) argues that Goethe's archetypal ideas are specifically Neoplatonic, in particular Plotinian, because they are "not transcendental entities, but immanent principles active within the natural world."

III. The Present

Modern science, especially physics, has continued on the trajectory established by Newton and is becoming more Pythagorean. For example, the most promising current scientific account of reality reduces everything to multidimensional *strings* vibrating harmonically in various patterns (e.g., Greene 1999). Truly, a Pythagorean vision! Since long before the arrival of string theory, however, the scientific perspec-

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(synthetic) orientation, whereas the latter has a sensation-thinking personality with an analytic orientation. The types are complementary and both are necessary for a comprehensive understanding. (Pauli notes the relation to ancient theories of beauty: the holistic theory of Plotinus (focusing on the whole) vs. the analytic theory of the Stoics and Aristotle (focusing on the parts). Heisenberg (1974c) explores the role of these complementary notions of beauty in the history of science.)

tive has been that the true structure of reality is very different from our sensory experience of it. Famously, the eminent physicist John Archibald Wheeler (1994) proposed the ontological maxim "it from bit" to express the idea that all the fundamental laws of physics are formal information relationships; there is no "stuff" that they are about, or to put it differently, the apparent stuff (such as strings, wavefunctions, fields, and particles) is constituted entirely by formal mathematical relationships. "Everything is number," indeed.

Another example of Pythagoreanism in contemporary science is *complex systems theory*, which attempts to find mathematical laws of emergence and self-organization throughout nature (e.g., Solé & Goodwin 2000).[9] The same laws are found to operate at many different levels, from atoms, to neurons, to embryological development, to social behavior and communication, to evolution, both cosmic and terrestrial. To put it differently, we find the same archetypal forms actualized in many different natural systems, and these archetypes govern the formation and transformation of these systems in space and time. These are laws dealing with the dynamics of opposites: expansion and contraction, cooperation and competition, uniformity and diversity, randomness and order, definiteness and indefiniteness, discreteness and continuity, and so forth. That is, Pythagorean ideas of unity, duality, conjunction and mediation, balance and equilibrium, and so forth, are found to be the fundamental principles at all levels of the cosmos, and so the structure of these Pythagorean archetypes is the structure of the universe, at least insofar as we can understand it.

IV. The Future

Next I will discuss several areas in which Neoplatonism can contribute to the future development of science by righting some of its imbalances and opening new paths for its progress.

One is in our orientation toward the natural world. For example, Preus (2002) argues that Plotinus (and later Neoplatonists) made

[9]. I do not claim that developments in complex systems theory were motivated in any direct way by Pythagorean or Neoplatonic philosophy. My point is that complex systems theory is Pythagorean in spirit, in that processes throughout nature are governed by a few fundamental mathematical archetypes, such as we find in Pythagorean philosophy.

"some very important contributions to the development of later biological thought, and in particular to the development of biological concepts which broke away from the dominance of Aristotelianism." They are among the sources of evolutionary theory, "the modern synthetic theory of living nature," and "the turn toward biological science, and away from the radical reductionism of modern physics, during the last hundred years or so." Indeed, it has been said that if the twentieth century was the century of physics, then the twenty-first will be the century of biology.

In MacLennan (2005) I argued that Neoplatonism, Jungian psychology, and evolutionary psychology are mutually consistent and mutually informative, so I will not repeat that discussion here (see also MacLennan 2003, 2006, in press). However, I will mention the following. On the one hand, Jungian psychology uses psychoanalytic techniques to investigate the archetypal structures common to the experience of all people, so its perspective is interior and phenomenological. On the other hand, evolutionary psychology (e.g., Buss 2004) seeks to explain various perceptual and behavioral structures common to all humans in terms of the evolution of *Homo sapiens* adapting to its historical environment; thus it explains these archetypal structures from an external perspective, that is, in behavioral or neuropsychological terms (Stevens 2003, chs. 1, 4). Both arrive at archetypal structures similar to those discovered by Neoplatonists and described in terms of gods, *daimones*, and archetypal numerical structures.

The mutual consistency of these perspectives is a consequence of the fact that the human genome defines the neural structures common to all people, and that these structures shape perception, experience, and behavior in ways that have proved providential for our species. These archetypal structures are not innate images, but "active living dispositions, ideas in the Platonic sense" (Jung 1969b, ¶154); indeed, many of them behave as autonomous personalities (gods, *daimones*), others as numinous structures and processes, such as triads, mandalas, and spiritual transformations (e.g., Jung 1969b, 1970, 1972). The deepest archetypes are the psychical correlates of neurophysiological and physical processes ultimately coextensive with nature itself (Jung 1968, ¶291, 1969b, ¶420; von Franz 1974, chs. 1–3; Jung & Pauli

1955; Stevens 2003, pp. 80–5). Thus they are the ultimate and unchanging ground of existence and of transpersonal meaning in our souls and in the universe. Neoplatonists know the various forms of them as the Ideas, "intellectuals," "intelligibles," henads, etc. (MacLennan 2005).

Furthermore, various psychoanalytic practices, such as "active imagination," which have proved valuable in the process of psychocognitive integration, have significant similarities to theurgy and other Neoplatonic spiritual practices (MacLennan 2005, in press). They are also consistent with shamanic and initiatory practices, which evolutionary psychologists explain in terms of their selective advantage for our species (Ryan 2002; Stevens 2003, ch. 10; Winkelman 2000).

The evolutionary Jungian perspective allows the insights and discoveries of Neoplatonists to make a positive contribution to the modern world-view, and to benefit from it in turn. On the one hand, evolutionary psychology can contribute to both Jungian psychology and Neoplatonism. It expands our understanding of the archetypal ideas and the process of psychological integration by placing them in their evolutionary context and by providing an approach to investigating their neurological correlates; in this way Jungian psychology may be coordinated with contemporary biology and neuroscience without abandoning its valuable and essential phenomenological orientation (Stevens 2003). Similarly, understanding the neurological correlates of Neoplatonic archetypal structures supplements the dialectical and phenomenological investigations of historical Neoplatonism with new, empirical techniques and insights from other scientific disciplines, which will revitalize Neoplatonism by resolving long standing problems and by suggesting new directions for its development (MacLennan 2005).

Conversely, Jungian psychology and Neoplatonism complement the primarily behavioral orientation of contemporary evolutionary psychology by contributing a phenomenological perspective, which takes seriously peoples' subjective experiences; thus it does not negate spiritual experiences in its attempt to explain them. The one-sided, primarily mechanistic and materialistic, orientation of evolutionary psychology will be completed by the psychospiritual dimension necessary for a humane understanding of the human psyche that is both intellectually and

emotionally satisfying (MacLennan 2006).

Thus, combining Neoplatonism with evolutionary Jungian psychology promises to unite our understanding of mind and matter in a theory transcending Cartesian dualism, which has perpetuated the intellectual and cultural hostility between science and spirituality. Perhaps it is not too optimistic to hope that this could help heal the widening rift between scientific and spiritual values in our culture.[10]

Balaguer (1998) analyzes the arguments for and against Platonic and anti-Platonic philosophies of mathematics, that is, of approaches to the ontological problem of the existence of mathematical objects. Of course, there are many variants of each of these philosophies, but Balaguer concludes that only one version of each is viable. On the Platonic side is *plenitudinous* or *full-bodied Platonism*, which is—roughly!—the idea that "all logically possible mathematical objects exist" (Balaguer 1998, p. 5). Balaguer concludes that both full-bodied Platonism and so-called anti-Platonic *fictionalism* are defensible, in that there are no sound arguments against either of them. He draws the further conclusion that there is no "fact of the matter" as to which view is correct, and indeed that there is no such fact of the matter for any abstract objects. Certainly, the latter conclusion can be considered a weakness of Platonism—and of anti-Platonism too—but I believe that additional sources of evidence can be found in support of Platonism.

Jungian psychology provides a different perspective on mathematical objects from that which is typical in the philosophy of mathematics, for Jungian psychologists have established that certain numbers and shapes are psychologically potent independently of any cultural or personal associations (Card 1996; von Franz 1974; Robertson 1989, 1995, ch. 19). For example, the number two has, in addition to its familiar quantitative properties, a qualitative aspect encompassing psychological experiences of duality, opposition, complementarity, and so forth (Jung 1970).

What is the foundation of the universal qualities of numbers, shapes, and other mathematical objects? Many of these are universal

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[10]. So also Card (1996) argues for a Jungian *archetypal* philosophy of nature, in the tradition of nineteenth-century *Naturphilosophie*, which was inspired by Goethean science and further developed the Neoplatonic concept of the *anima mundi*.

because they are rooted in the neuropsychology common to all humans. In particular, I think it is likely that the qualitative character of the numbers, especially in their more dynamical aspects, can be found in the neurodynamics of the nervous system (von Franz 1974, p. 7; Jung 1969b, ¶420; MacLennan 2006). For example, neurodynamical processes underlie our experiences of clear differentiation, cognitive dissonance, and so forth, which are part of the qualitative experience of the dyad. So also experiences associated with unity, such as mental coherence and settling on a conclusion, are rooted in neurological processes. Indeed, Lakoff and Núñez (2000) have shown that many mathematical concepts, even in such abstract systems as set theory, are rooted in our embodied interactions with the physical world, for which our nervous systems have been adapted by evolution.

Therefore, a Neoplatonic or, more precisely, a Neopythagorean approach to the foundations of mathematics that is understood in the context of evolutionary Jungian psychology offers potential advantages over the usual philosophies of mathematics, for it will expose the neurophenomenological foundations of mathematical concepts in their psychological fullness, that is, their qualitative aspects as well as the quantitative (von Franz 1974). From this perspective, mathematical objects, like the other archetypes, are both psychical and objective, for they reside in what Jung called the objective psyche, the network of psychological structures common to all humans (Stevens 2003, p. 65).[11]

Since contemporary science is essentially mathematical, such an enriched understanding of mathematics can help us to understand the unconscious cognitive-emotional structures that condition all of our scientific enterprises (Pauli 1955, pp. 208–9). It may help us to understand criteria of symmetry, beauty, and elegance by which mathematical and scientific theories are judged, which contribute to their acceptance, and which motivate the search for confirming evidence (Curtin 1982; Heisenberg 1974c). It may help explain the, essentially non-scientific, sources of scientific hypotheses and models, especially when they are mathematical in form. Thus, in a previously unpublished paper, Pauli

[11]. Interestingly, Kepler attributes to Proclus ("his favorite author") the idea that innate archetypes, especially of mathematics, are instincts (*instinctus*) (Pauli 1955, pp. 162, 165).

argues for "a future description of nature that uniformly comprises physis and psyche," and that to achieve such "it appears to be essential to have *recourse* to the archetypal *background of scientific terms and concepts*" (Meier 2001, p. 180). At a more fundamental level, this unified description may deepen our understanding of the psychological components of scientists' preference for quantification, clear and distinct mathematical structures, definite standards of proof, abstraction and formalism, and other features of contemporary scientific practice that are familiar but not inevitable. Therefore Pauli (1955, p. 208) argues that henceforth the only acceptable scientific view will be "the one that recognizes *both* sides of reality—the quantitative and the qualitative, the physical and the psychical—as compatible with each other, and can embrace them simultaneously."[12]

V. Conclusions

As modern science emerged in the seventeenth century and displaced the magical philosophy, it incorporated a number of ideas from the Neoplatonic and Neopythagorean tradition, including the notion that there is a hidden structure of abstract, and especially mathematical, ideas underlying reality and giving rise to visible phenomena. However, these notions were imported into a dualist framework in which an inanimate, or soulless, mechanical world is opposed to *man*—and I use the gendered term intentionally—as observer and exploiter. Over the past four hundred years, the self-reinforcing processes of science and society have widened this gap, and an increasingly remote and abstract relation to physical reality has led scientists, technologists, and consumers to withdraw from empathetic participation in living nature. Further, with the advance of materialist, quantitative science the human soul has, of course, been pushed further and further into the margins, alienating many people from science.

I think that some of these disharmonies among ourselves, and between humans and the rest of nature, may be eliminated by returning to the Neoplatonic well, which has already nourished science, and by drinking deeply from it again. For Neoplatonism can unite with evolu-

[12]. See Card (1996) for the prospects for a future archetypal philosophy of nature and its application in several scientific disciplines.

tionary Jungian psychology to reveal the objective archetypal Ideas, which inform our relations to each other, to the natural world, and to the spiritual realm, but which also underlie our scientific concepts and our most abstract theories. In particular, by acknowledging the psychological and phenomenological reality of our experience of these archetypal Ideas, we transcend the Cartesian gap, not by reducing all phenomena to inert matter, but by recognizing the equally objective psychical and physical aspects of a unitary reality.

For these archetypal Ideas are not abstract, inert quantities, but qualities full of the richness of human experience, living and dynamic, brimming with symbolic meaning, emotional and spiritual as well as intellectual. From this perspective, even the most materialist of issues are understood to have an equally valid and objective spiritual aspect, accessible to empirical investigation, in the broad sense. Materialist values are not complete in themselves, but must be complemented by non-materialist, but nevertheless objective, values.

Certainly, the goal of such a Neoplatonic renewal of science and technology is not to replace current approaches to science, but to expand the human relation to nature in ways that will enrich our understanding, and to lay a foundation for an environmentally sensitive technology. As a consequence we may also anticipate the continued evolution of Neoplatonism as a *living* philosophy.

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