JUNG AND PAULI
A Meeting of Rare Minds

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Readers of the Swiss psychiatrist C. G. Jung are more familiar with Wolfgang Pauli's unconscious than with his waking life and achievement. Through Jung's *Psychology and Alchemy*—an exposition of "the problem of individuation" and "normal development . . . in a highly intelligent person"—depth psychologists have known the Nobel laureate's dreams, not his professional genius. Meanwhile, the scientists who continue Pauli's pursuit of the nature and composition of the material universe know little of the quantum physicist's depth exploration of his unconscious, his fascination with the interface of matter with psyche, and his collaboration with Jung in probing connections that appear to be acausal.

In turn, many who know Jung's studies of psychic phenomena are not so at ease with his development of the parallels between psychic process and the material matrix in which the mental is embedded. For those who lack Jung's scientific background and grasp, his claim of an empirical method, his pursuit of the metaphors of alchemy, and his evocation of analogies in physics to psychic mechanisms have seemed far-fetched, tangential, difficult, or unnecessarily encumbering. Yet Jung persisted in pursuing the physical and meditative experiments of the alchemists and in perusing the findings of contemporary scientists. Throughout his career, Jung argued that his work would carry the gravitas of the relevant and enduring only if it had both a place in the history of thought and a context in the modern disciplines.

This collection of letters between Jung and Pauli offers insightful information about a relationship that was valuable for both analytical psychology and quantum physics, two realms of investigation that at first seem to have no point of contact. Historically, physical science and religion have focused, from different perspectives, on the sources of the universe and its inhabitants. Religion and psychology, in a similar fashion, have had overlapping concerns about the nature of existence. Science traditionally seeks the most fundamental, objective, and universal facts by confirming and measuring external reality through experiments. Psychology, however, while presuming both norms and anomalies in its dynamic descriptions and differential

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diagnoses, is concerned primarily with subjective experience and individual apprehension.

As psychology describes psychic contents with psychic means, psyche is subject and object, medium and message, source and goal; there is no point of observation outside the human psyche. Physics, by contrast, pursues material reality both via and, to the greatest degree possible, beyond the human experience, but it also uses the mental medium in both its conceptions and inventions. While it utilizes impersonal and unvalenced measures, the questions and thus the proofs originate in and are dependent on the human mind. In this sense, our grasp of the universe is essentially anthropic. Also, as a contemporary Nobel laureate, the particle physicist Steven Weinberg, reminds us, "we cannot require that all experiments should give sensible results," because "by definition there is no observer outside the universe who can experiment on it."[1]

The letters between Pauli and Jung reveal two large minds in a twenty-six-year correspondence about fields of expertise that, it could be argued, saw the most extensive developments in the Western intellect in the twentieth century. Each scholar was intent on moving the boundaries between the known and unknown in his own tradition. Each had the imagination to cross the lines within, beyond, and between their disciplines in order to search for the links between the observable and the unknowable. Each, too, had the humility essential to look for precedents in the past, as well as the arrogance necessary to risk speculation about the future.

Each thinker was concerned with the effect of the particular and specific on the universal. Jung's concern was individual experience: the psyche's perception and conception, emotion, and imagination regarding inner and outer realities. He focused on the individual's psychic development as it interrelated with recurring, and thus collective, predispositions and representations of human experience. He was especially curious about the ways in which images produced by the psyche become unprovable but assumed beliefs. Pauli sought to prove theories about the nature of the tiniest particles in the ever-extending energy patterns of the material universe and to find the formulas and means of measurement that would reveal the universe's past, present, and future. While focusing on the most fundamental elements in the world's makeup, as a quantum theorist Pauli was also alert to the effect of the particular presence of the observer on what is observed.

Complementarities

Jung (1875–1961) and Pauli (1900–1958) met in 1930, when Pauli, in life distress and psychic despair, sought out Jung for direction in attending to his emotional and psychological pain. While never Pauli's analyst, Jung re-

[1] Weinberg 1994a, p. 48.

viewed thirteen hundred of Pauli's dreams and studied a selection from the first four hundred of these. Over years of contact, the younger man's knowledge penetrated and influenced Jung's thought.

In 1952, Jung and Pauli published a juxtaposition of their ideas in *The Interpretation of Nature and the Psyche*. In their work, they crossed paths on complementary vectors.

> As the phenomenal world is an aggregate of the processes of atomic magnitude, it is naturally of the greatest importance to find out whether, and if so how, the photons (shall we say) enable us to gain a definite knowledge of the reality underlying the mediative energy processes. . . . Light and matter both behave like separate particles and also like waves. This . . . obliged us to abandon, on the plane of atomic magnitudes, a causal description of nature in the ordinary space-time system, and in its place to set up invisible fields of probability in multidimensional spaces.[2]

Pauli? No, Jung.

> Division and reduction of symmetry, this then the kernel of the brute! The former is an ancient attribute of the devil. . . . If only the two divine contenders—Christ and the devil—could notice that they have grown so much more symmetrical![3]

Jung? No, Pauli, in a letter written a year before his death to Werner Heisenberg, a lifelong friend and colleague.

By the time that Jung met Pauli, he had been deeply affected and "tremendously impressed" for nearly three decades by William James. In *Principles of Psychology*, James posited coexisting and possibly split modes of consciousness—the "upper self" and the "under self"—which even while mutually unaware of and ignoring each other have complementary effects on each other. In *The Varieties of Religious Experience*, James wrote of the "field" that, despite the indeterminacy of its margins, guides attention and behavior.[4] Jung adopted the Jamesian notion of psychic fields and the language regarding the complementary nature of the constituents of the psyche. When he was a psychiatrist at the Burghölzli clinic, trying to grasp the import of the striking images produced by disturbed patients, Jung began to find precedents for them in mythology, philosophy, religion, alchemy, and the historical notions of the natural sciences. At first compelled by the contents of these images, Jung became consistently more concerned with the process in and for which the psyche produced them. He postulated that dreams and autonomous fantasies were the complementary conceits by which the psyche attempts to retrieve or complete its knowledge in pursuit of greater consciousness and, in cases of imbalance or damage, to reestablish equilibrium and heal internal splits.

[2] Jung 1947, par. 438. [3] Heisenberg 1971, p. 234. [4] Card 1991b, pp. 52–53.

James also perceived and named the complementarity between physical and depth-psychological fields, and

> drew attention to the correspondence of the concept of field in physics with the newly formulated psychological concept of the subconscious. It is thought that physicist Niels Bohr also borrowed from James the term complementarity, with which Bohr formulated the Principle of Complementarity that characterized his philosophy of nature.[5]

As a professor at Zurich's Eidgenossische Technische Hochschole (ETH), a leading university in the sciences, Jung was exposed to current theory. He saw psychology as an empirical science of observation, exploration, and ongoing reformulation. Throughout his life, he remained convinced that just as matter is in a constant process of redefinition, so too must psyche and spirit be continuously redefined. The development of Jung's thought and that of physics in the first half of the twentieth century are both complementary and symmetrical. In the studies on the association experiment that Jung published in 1904 to 1906 with Franz Riklin, he described psychological complexes as knots of psychic energy, each with its own agenda, charge, and resonance. The existence of these fields in the personal unconscious relativized the consciousness and autonomy of the ego.

In 1905, Albert Einstein's annus mirabilis, "while also working out the quantum theory of light and a theory of the motion of small particles in fluid, Einstein developed a new theory of space and time, now called the special theory of relativity."[6] Jung recalled that he had met Einstein in the "very early days when [he] was developing his first theory of relativity. . . . His genius as a thinker . . . exerted a lasting influence on my own intellectual work."[7] In the Tavistock lectures, Jung remembered, "I pumped him about his relativity theory. I am not gifted in mathematics. . . . I went fourteen feet deep into the floor and felt quite small."[8] In 1928, when Jung received the German translation of a Chinese alchemical treatise called "The Secret of the Golden Flower" from Richard Wilhelm, he felt immediate sympathy with the Chinese notion of time as a continuum in which certain qualities manifest relatively simultaneously in different places. In his 1929 essay on the "Golden Flower" and his 1930 Wilhelm memorial, Jung made reference to what he would call synchronicity as a parallelism of events that cannot be explained causally. Jung's reading of alchemy took him into a deep study of "all kinds of opposites" and, as he wrote twenty-five years later, led eventually to his understanding of the unconscious as a process.

In *Dreams of a Final Theory*, Weinberg observes that Einstein's 1915 special theory of relativity "fit in well with a dualistic view of nature: there are

[5] Ibid.
[6] Weinberg 1994, p. 98.
[7] Jung 1974, p. 109.
[8] Jung 1968, par. 140.

particles, like the electrons, protons, and neutrons in ordinary atoms, and there are fields, like the gravitational or the electromagnetic field."[9] Just five years later, the twenty-one-year-old Pauli, rather than feeling "fourteen feet deep into the floor," published his own critique of this relativity thesis. Einstein wrote:

> No one studying this mature, grandly conceived work could believe that the author is a man of 21. One wonders what to admire most, the psychological understanding for the development of ideas, the sureness of mathematical deduction, the profound physical insight, the capacity for lucid systematic presentation, the complete treatment of the subject matter, or the sureness of critical appraisal.[10]

In 1926, using his classmate Heisenberg's matrix mechanics, Pauli produced a quantum-mechanical calculation of hydrogen energy levels. It was an "exhibition of mathematical brilliance, a sage-like use of Heisenberg's rules and the special symmetries of the hydrogen atom. . . . No physicist alive was more clever."[11] Pauli thus validated quantum mechanics, most simply described as "the study of the behavior of atoms and their constituents. Quantum is the Latin word for so much or bundle, and mechanics is the old term for the study of motion. Quantum mechanics is the study of the motion of things that come in little bundles"—in contrast to a relativity theory based on the assumption of point particles.[12]

By age twenty-eight, Pauli held the chair of theoretical physics in Zurich. With Bohr and Heisenberg, he arrived at a new philosophy for subatomic matter. In 1929, Pauli and Heisenberg presented a field theory of physics that elided the distinction between matter and force. They described both particles and forces as manifestations of a deeper level of quantum fields in which "not only photons but all particles are bundles of energy in various fields . . . electrons are bundles of the energy of the electron field; neutrinos are bundles of the energy of the neutrino field; and so on."[13]

Meanwhile early in his career during his short but intense relationship with Freud, Jung had struggled with a sexually based drive theory. By the time he spoke at Harvard in 1932, Jung had identified at least five kinds of drives: hunger, activity, sexuality, creativity, and reflection. But he gradually came to conceive of "libido as a psychic analogue of physical energy, a more or less quantitative concept, which should not be defined in qualitative terms . . . [nor in] the prevailing concretism of the libido theory." He later recalled to Aniela Jaffé: "I wished no longer to speak of the instincts of hunger, aggression, and sex, but to regard all these phenomena as expressions of psychic energy." He said:

[9] Weinberg 1994, p. 141.
[10] Peat 1991, p. 15.
[11] Weinberg 1994, p. 69.
[12] Hazen and Trefil 1992, pp. 65–66.
[13] Weinberg 1994, pp. 171–72.

> In physics, too, we speak of energy and its various manifestations. . . . The situation in psychology is precisely the same. . . . We are dealing primarily with energy, with measures of intensity, with greater or lesser quantities . . . in various guises. If we conceive of libido as energy, we can take a comprehensive and unified view . . . such as is provided in the physical sciences by the theory of energetics. . . . I see man's drives as various manifestations of energic processes . . . forces analogous to heat, light, etc.[14]

Jung's notion of the archetypes of the collective unconscious implied, so to speak, a supercharge, an "overplus," of energy emerging from those "fields" of interrelated experience that the human psyche is predisposed to find significant. For Jung, archetypes are not structures but "habitual currents of psychic energy," "systems of readiness for action." Pauli refers to them as "statistical laws with primary probabilities." These exist before and beyond the only personal data of the individual time-and-space-bound ego and so further relativize it. Late in his life, Jung remarked in a filmed interview that Einstein "first started me off thinking about a possible relativity of time as well as space and their psychic conditionality. More than thirty years later, this stimulus led to my relation with the physicist Professor W. Pauli and to my thesis of psychic synchronicity."[15]

Pauli and Jungian Analysis

In his physics, Pauli sought a unified field. But his personal life was one of fragmentation and dissociation. Within one year, his mother poisoned herself in reaction to his father's involvement in an affair, and Pauli plunged into a brief marriage with a cabaret performer. At thirty, he turned to Jung for help.

Jung, in his 1935 lectures at the Tavistock, offered the following example of dreams effecting change:

> I had a case, a university man, a very one-sided intellectual. His unconscious had become troubled and activated; so it projected itself into other men who appeared to be his enemies, and he felt terribly lonely because everybody seemed to be against him. Then he began to drink in order to forget his troubles, but he got exceedingly irritable and in these moods he began to quarrel with other men. . . and once he was thrown out of a restaurant and got beaten up.[16]

Jung saw that "he was chock-full of archaic material, and I said to myself: 'Now I am going to make an interesting experiment to get that material absolutely pure, without any influence from myself, and therefore I won't touch it.'" He referred Pauli to Dr. Erna Rosenbaum, "who was then just a

[14] Jaffé 1965, pp. 208–9. [15] Jung 1974, p. 109. [16] Jung 1968, par. 402.

beginner. . . . I was absolutely sure she would not tamper." Pauli applied the same passionate brilliance to his unconscious as to his physics. In a five-month Jungian analysis, Pauli recorded and spontaneously illustrated hundreds of his dreams. "He even invented active imagination for himself. . . . He worked out the problem of the *perpetuum mobile*, not in a crazy way but in a symbolic way. He worked on all the problems which medieval philosophy was so keen on."[17] For three months, "he was doing the work all by himself, . . . for about two months, he had a number of interviews with me. . . . I did not have to explain much." Jung believed Pauli "became a perfectly normal and reasonable person. He did not drink any more, he became completely adapted and in every respect normal. . . . He had a new center of interest." Jung had thirteen hundred of Pauli's dreams as the basis for his research into alchemical symbolism in a modern psyche. "At the end of the year I am going to publish a selection from his first four hundred dreams, where I show the development of one motif only."[18]

The physicist F. David Peat believes Jung's assessment of Pauli's state after his termination with Dr. Rosenbaum was too positive. Pauli's new "reasonableness" didn't last, and later he again drank excessively.

While Pauli's work aimed toward a "psychophysical monism," his intense inner tensions seemed to manifest physically in the so-called Pauli Effect, when his mere presence caused laboratory equipment to explode or fall apart.[19] His internal "monotheism" and his sharp critical acumen and tongue earned him the titles "scourge of God," "the whip of God," and "the terrible Pauli." Even in the midst of personal disarray, Pauli kept his stance as a scientist of such rigor that he was called "the conscience of physics." Asked whether he thought a particular physics paper was wrong, he replied that was too kind—the paper was "not even wrong."[20] Heisenberg's account of a 1927 conversation reveals that, in his youth, Pauli was concerned about the distinctions between knowledge and faith.[21] Heisenberg saw that behind Pauli's

> outward display of criticism and skepticism lay concealed a deep philosophical interest, even in those dark areas of reality or the human soul which elude the grasp of reason. And while the power of fascination emanating from Pauli's analyses of physical problems was due in some measure to the clarity of his formulations, the rest was derived from a constant contact with the field of the creative and spiritual processes for which no rational formulation as yet exists.[22]

For Pauli, the creativity of science included considerations of the psyche. In science, he subscribed to the quantum uncertainty theory that the

[17] Ibid., par. 403
[18] Ibid., pars. 404–6.
[19] van Erkelens 1991, p. 41.
[20] Weinberg 1994, p. 257.
[21] Heisenberg 1971, pp. 82–91.
[22] Heisenberg 1974, p. 30.

position and presence of the observer changes the perception and reality of what is observed. To that thesis—that one cannot measure the wave and the particle at the same time—he added a psychological dimension, observing that insofar as the scientist must opt to know "which aspect of nature we want to make visible . . . we simultaneously make a sacrifice, . . . [a] coupling of choice and sacrifice."[23]

Pauli demonstrated the value of intuition to science's empiricism. As Weinberg recounted,

> physicists in the early 1930's were worried about an apparent violation of the law of conservation of energy when a radioactive nucleus undergoes the process known as beta decay. In 1932, Wolfgang Pauli proposed the existence of a convenient particle he called the neutrino, in order to account for the energy that was observed to be lost in this process. The elusive neutrino was eventually discovered experimentally over two decades later. Proposing the existence of something that has not yet been observed is a risky business, but it sometimes works.[24]

In a metaphysical leap, Pauli referred as well to "forms belonging to the unconscious region of the human soul" and stated that "the relation between a sense perception and Idea remains a consequence of the fact that both the soul and what is known in perception are subject to an order objectively conceived."[25] He acknowledged that he had realized in a dream that the quantum-mechanical conception of nature lacked the second dimension, which he found provided by the archetypes of the unconscious.

It seems, however, that he could not find his way to the uncertainty, the "choice and sacrifice" that allows for reparation within analysis. While Pauli knew "that a truly unified view must include the feeling function, since without feeling there is no meaning or value in life, and no proper acknowledgment of the phenomenon of synchronicity," M.-L. von Franz said that he later sought only a "philosophical discussion of dreams":

> He wrote to me . . . [and] made it clear that he did not want analysis; there was to be no payment. I saw that he was in despair, so I said we could try. The difficulties began when I asked him for the associations which referred to physics. He said, "Do you think I'm going to give you unpaid lessons in physics?" . . . He wanted something, but he didn't want to commit himself. He was split.[26]

Van Erkelens speculates that Pauli would have had to submit to a transference and to a deeper Eros than "his inner urge to develop a unified view of matter and spirit." For whatever reasons, von Franz and Pauli were not able

[23] Heisenberg 1974, pp. 35–36.
[24] Weinberg 1994, pp. 196–97.
[25] Heisenberg 1974, pp. 31–32.
[26] Sieg 1991, p. 56.

to achieve the relational bond that holds and contains explosive emotional material and so allows surrender to one's unconscious and to a suffered analytic relationship.

Jung and Pauli corresponded and later met, not for analysis but for a comparison of ideas—Pauli pursuing Jung's synchronicity thesis and Jung fostering Pauli's understanding of the archetypal and collective factors in the psyche. Through their contact, William James's two fields, to which both Jung and Bohr had been attracted, come together again. Von Franz writes that the

> notion of complementarity introduced by Niels Bohr to provide a better explanation for the paradoxical relationship between waves and particles in nuclear physics can also be applied to the relationship of conscious and unconscious states of a psychic content. This fact was discovered by Jung, but it was particularly elaborated by Wolfgang Pauli.[27]

Quantum Science and Alchemy

"Quantum mechanics and special relativity are nearly incompatible," writes Weinberg, "and their reconciliation in quantum field theory imposed powerful restrictions on the ways that particles can interact with each other."[28] In Peat's view, Pauli's insight was "that, at the quantum level, all of nature engages in an abstract dance" and is divided into two groups, "according to whether they engage in an antisymmetric or a symmetric dance." This was the basis for a major theoretical contribution, the Pauli exclusion principle, indicating the strongest taboos and most powerful restrictions on the ways particles behave, His "notions of symmetry within the quantum domain" explain why particles with the same energy are always apart from each other. "This exclusion of particles from each other's energy space . . . arises out of . . . the abstract movement of the particles as a whole." It is then "the underlying pattern of the whole dance [that] has a profound effect on the behavior of each individual particle."[29] Simply put, two electrons in an atom can never have the same set of quantum numbers. One electron's presence keeps another electron with the same quantum numbers from getting too close, causes electrons in an atom to stack up in a series of energy levels, and prevents electron stacks from collapsing into the lowest-energy quantum state. Only so many electrons fit into a single orbit before quantum numbers duplicate. So the Pauli rule requires that if there is one more electron than can be accommodated in an atomic orbit, that electron must be in a separate orbit. This breakthrough in technical understanding loops back to alchemy, as the exclusion principle offers the basis for the structure of the

[27] von Franz 1992, pp. 245–46.
[28] Weinberg 1994, p. 142.
[29] Peat 1987, p. 16.

periodic table of chemical elements. This in its turn informs science's realization of the alchemical goal.

> It was not until the Twentieth Century and the atomic age that men were enabled to change the elements into one another. Such processes of metallic transmutation consist in changing the number of protons in the atomic nucleus of the basic elements. If iron is to be changed into gold, 53 protons must be added to its nucleus of 26 protons, if it is to be transformed into the element of gold which carries 79 protons in its nucleus.[30]

Symmetry

There is another subtle and profound link between the intuitive if clumsy probings of alchemy and Pauli's work, based on his use of symmetry and its effects. Symmetry is a roving and variable concept, used and applied differently to objects, categories, and laws in various fields, including aesthetics, mathematics, and physics. It may describe symmetries of things—faces, crystals, cubes of salt—as well as internal symmetry principles that "impose a kind of family structure on the menu of possible particles,"[31] and "the symmetries that are really important in nature . . . the symmetries of laws which state 'that when we make certain changes in the point of view from which we observe natural phenomena, the laws of nature we discover do not change.' So the "symmetry principle is simply a statement that something looks the same from certain different points of view."[32] But in the mathematics relevant to Pauli, "a symmetry isn't a thing; it's a transformation. Not any old transformation, though, a symmetry of an object is a transformation that leaves it apparently unchanged."[33] Symmetry also states that all elements of a system can undergo transformations—rotation or reflection in a mirror—without being fundamentally altered and so "has become the epitome of truth and beauty."[34] Symmetry is implicit in such alchemical dictums as "For there is one stone, one medicine, to which nothing from outside is added, nor is it diminished, save that the superfluities are removed." It is more explicit in the motto "as above, so below; as within, so without."

The alchemists imaginally and physically aimed toward succeeding stages of conjunctions between pairs, couplings, and asymmetric symmetries, both in physical experiments and in psychic attempts to achieve inner balance. Their intent was to provide the purest, perfect, most inclusive physical substances, as well as internal integration. Their motive was to replicate or imitate the original oneness, when all was potential in the mind of the creator, before it dispersed into the four directions, four elements, and discrete forms.

[30] Fabricius 1989, p. 8.
[31] Weinberg 1994, p. 154.
[32] Ibid., pp. 136–37.
[33] Stewart and Golubitsky 1992, p. 28.
[34] Horgan 1994, p. 99.

The alchemists worked toward symmetries of all kinds of opposites to reach both backward and forward toward the one. Symmetries in physics operate with varying degrees of sophistication and complexity in Newton's mechanical relativity, in Einstein's space-time relativity, and in quantum mechanics. From the perspective of current physics, Weinberg writes, Heisenberg's and Pauli's quantum-field theory is "on the track of something universal—something that we call the laws of nature . . . [a] theory that rigidly will allow us to describe the forces—gravitational, electro-weak, and strong—that actually as it happens do exist."[35]

The alchemists played with their sulphurs, mercuries, and salts to reintegrate elements and to provide themselves with imagery on which to meditate as they sought equilibria between soul, spirit, and body. Particle physicists now deal with thousands of numbers involved in the properties of the elementary particles known to date. While the conscious intent is entirely physical and not psychological, the symmetry principle carries on the search for "the beauty of simplicity and inevitability—the beauty of perfect structure, the beauty of everything fitting together, of nothing being changeable, of logical rigidity."[36]

From Jung's perspective of the psyche's tendency toward an ordering, mandalic pattern of compensation, it follows that in the attempt to deal with inner fragmentations Pauli, as a scientist, was deeply drawn to the notion of a unifying principle. For Pauli, symmetry was the archetypal structure of matter. Just as the alchemists looked for the substratum of reality beneath matter, he came to the view that the elementary particles were not themselves the ultimate level of reality. As he became more familiar with alchemy as a psycho-physical unity, Pauli saw the same *lumen naturae*, the light of nature, or the "spirit in matter," glimpsed by Paracelsus and Jung. "Rather than seeking the ultimate level of nature in terms of elementary particles, Pauli believed that the material level is the manifestation of something deeper, an Unus Mundus that is also the domain of symmetry," where mind and matter, religion and science originate.[37]

During his fifties, Pauli concluded that in order to develop a unified framework for modern physics and depth psychology, "besides physics, psychology, and a neutral language, a fourth element is needed—Eros."[38] He went so far as to define physical knowledge as the meeting place of inner psychological images and outer facts.[39] This accords with the view that it is "the self-same reality which, looked at from within and from without" is described by alchemy, depth psychology, and physics, as "we largely concern ourselves with the same subject, that unknown living factor . . . the animating power in matter which for want of a better name we now call the unconscious."[40]

[35] Weinberg 1994, p. 147.
[36] Ibid. p. 149.
[37] Peat 1988, pp. 16–17.
[38] van Erkelens 1991, p. 43.
[39] von Franz 1992, p. 13.
[40] Ibid., p. 169.

In his domain, Jung came to see the psyche as one force containing multiple perspectives, "a multiplicity within unity." He increasingly saw psychic energy as a large field from one source, with two complementary but not incompatible conduits, the conscious and the unconscious. These exist between the subjective and objective, emerging from a mind-matter continuum that can only partially observe itself, which Jung came to call "psychoid." Just as Pauli perceived physical knowledge as the meeting place of inner psychological images and outer facts, Jung extended from his psychic end into the spectrum of matter. The inclusion of subjectivity in quantum observation was seen as complementary to Jung's assertion of "the objective reality of the archetypes."[41] Jung credits C. A. Meier for the insight regarding "the parallelism of psychological and physical explanations" through which relations of complementarity are seen to exist not only within psychology and physics but also between them in "a genuine and authentic relationship of complementarity as well."[42]

From 1946 onward, Jung further differentiated his concept of the archetype as transconscious—that is, as beyond psychic integration and thus psychoid. It is also transpsychic insofar as "not purely psychic but just as much physical in nature." As the unknowable structuring element in the collective unconscious, it also arranges the registering of acausal events.[43] Matter and mind are both objective and subjective, complementary in their structure and, at the psychoid level, reflective of each other. Further, as he wrote in his last major work, "we do not know whether what we on the empirical plane regard as physical may not, in the Unknown beyond our experience, be identical with what on this side of the border we distinguish from the physical as psychic. . . . They may be identical somewhere beyond our present experience." He also anticipated further research: "Microphysics is feeling its way into the unknown side of matter, just as complex psychology is pushing forward into the unknown side of psyche. Both . . . have yielded findings . . . and both have developed concepts which display remarkable analogies."[44]

Synchronicity

In their joint volume, Jung and Pauli presented the synchronicity principle. It presumes that indestructible energy has a dual relationship to the space-time continuum: on the one hand, there is the constant connection through effect—that is, causality; and on the other, there is an inconstant connection through contigence, equivalence, or meaning that is itself synchronicity.[45] For a physicist, equations are not objectively accurate reflections of

[41] Card 1991b, pp. 53–54.
[42] Jung 1947, par. 439.
[43] Jaffé 1968, p. 7.
[44] Jung 1968, par. 765–68.
[45] von Franz 1992, p. 218.

material reality but structurally accurate relationship-connections. For Jung, synchronicities are meaningful only when an individual experiences them. This creates another "relationship of complementarity between the occurrence or cessation of synchronistic phenomena and the relative state of unconsciousness or consciousness of the individual who experiences it."[46]

Synchronistic events are inconstant, sporadic, and arbitrary, for they are dependent upon an excited archetypal situation in the observer. In an accidental but meaningful perception of a coming together of inner and outer events—of making or perceiving a connection between the inwardly experienced and the outwardly perceived—there is usually a felt sense of participating in "acts of creation in time." This is similar to the sensibility of religions based on individual experience of the manifest, such as the ancient Egyptian and the Native American.

For Peat, Pauli's "discovery of an abstract pattern that lies hidden beneath the surface of atomic matter and determines its behavior in a noncausal way" links the Pauli principle to the physical basis of synchronicity:

> Just as Einstein added time to space to produce the much deeper concept of space-time, so Jung proposed completing causality by adding a noncausal link. Certain patterns, he argued, are linked in nonmechanical ways to form a "causeless order." . . . its patterns are meaningful and are echoed in both mind and matter.[47]

Concerning the nonpsychic "psychoid sphere" that "forms a bridge to matter," Jung associated acausal orderedness with the quantum-physics engagement of momentum and energy without "classical determination of a precise location in space and time."[48] His formulation of the interaction between the unconscious and conscious follows the alchemical conceit of the *coniunctio*. He identified its imagery of king and queen in the poses of intercourse as suggestive of the alternating positions of the conscious and unconscious. This may be seen as a psychic analogy to the proposition in uncertainty theory that wave and particle are in constant juxtaposition, though only one can be perceived and measured at one time. In this comparison, the movements of the unconscious into consciousness are like waves of psyche manifesting at nodal points as particles of consciousness.

Analogy and Metaphor

It might be said that, whereas the Freudian metaphors of psychodynamics are of the nineteenth-century mechanical genre, the Jungian perspective, through alchemy and particle physics, adds sixteenth- and twentieth-century metaphors. The genetic interpretations of the reductive approach

[46] Card 1991b, p. 54. [47] Peat 1991, pp. 17–18. [48] Card 1991a, p. 27.

are consonant with a Newtonian world of cause and effect. When the unconscious is perceived as preceding and antedating the ego and capable of compensatory comment on what is experienced consciously, the ego exists in space-time relativity. When the complexes are vital stimuli in compulsive instinct, overwhelming emotion, archetypal identification, we can conceptualize fields of quantum bundles. But are these analogies valid beyond use as fanciful metaphors?

A psychological theorist, Julian Jaynes, questions the relevance of psychology's use of scientific metaphor. He refers to "a delusion in our reasoning" and a "huge historical neurosis. Psychology has many of them. And one of the reasons that the history of science is essential to the study of psychology is that it is the only way to get out of and above such intellectual disorders."[49] He argues that

> each age has described consciousness in terms of the images of its external gestalt. In the golden age of Greece, when men traveled about in freedom while slaves did the work, consciousness was as free as that . . . an enormous space whose boundaries . . . could never be found out. . . . Augustine among the caverned hills of Carthage was astonished at the "mountains and hills of my high imaginations," "the plains and caverns of my memory."[50]

Jaynes refers to the first half of the nineteenth century as "the age of the great geological discoveries. . . . This led to the popularization of the idea of consciousness as being in layers." Then, "in the middle of the nineteenth century, chemistry succeeded geology as the fashionable science, and consciousness . . . was a compound structure that could be analyzed in the laboratory. . . . As the steam locomotives chugged their way, . . . the subconscious becomes a boiler of straining energy." He then notes that "when the astonishing successes of particle physics were being talked of everywhere," when "the solidity of matter was being dissolved into mere mathematical relationships in space," this seemed to psychologists like the same unphysical duality as the relationship of individuals conscious of each other.[51]

In contrast to Jaynes's critique, Arthur Koestler sees that "all decisive advances in the history of scientific thought can be described in terms of mental cross-fertilization between different disciplines."[52] (And for the cultural critic George Steiner, "even the illicit metaphor, the term borrowed though misunderstood, may be an essential part of a process of reunification. It is very probable that the sciences will furnish an increasing part of our mythologies and imaginative reference."[53] Even Jaynes admits that the

[49] Jaynes 1990, p. 7.
[50] Ibid., p. 2.
[51] Ibid., pp. 3–4.
[52] Koestler 1964, p. 35.
[53] Steiner 1969, p. 35.

"concepts of science are all . . . abstract concepts generated by concrete metaphors. In physics we have force, acceleration (to increase one's steps), inertia (originally an indolent person), impedance, resistance, fields, and now charm."[54]

"What I have argued so far is this," writes Steiner.

> Until the seventeenth century, the sphere of language encompassed nearly the whole of experience and reality; today it comprises a narrower domain. It no longer articulates or is relevant to all major modes of action, thought, and sensibility. Large areas of meaning and praxis now belong to such non-verbal languages as mathematics, symbolic logic, and formulas of chemical or electronic relation.[55]

And conversely, the physics, mathematics, and astronomy sections of bookstores now carry such titles as *The God Particle: If the Universe Is the Answer, What is the Question?*; *The Mind of God*; *Fearful Symmetry: Is God a Geometer?*

For Jung, "the common background of microphysics and depth psychology" is as much physical as psychic, and so is "neither, but rather a third thing, a neutral nature which can at most be grasped in hints since in essence it is transcendental."[56] Pauli sought "to find a new language that could make the hidden dimension in nature accessible to the intellect . . . neutral with respect to the distinction between psyche and matter . . . from the physical and mathematical symbols . . . in his dreams." He alluded to the self as the "radioactive nucleus," and in a 1950 letter to Emma Jung he described synchronistic phenomena as "radioactivity."[57]

Symmetry and Asymmetry

While he believed physics was in transition toward fuller understanding, Pauli's own attachment to symmetry came nearly to dominate the Self. Von Franz believes he had come "to believe in symmetry as a form of god," as stable and unchanging. Pauli held that symmetry—also called "even-handedess" in broad analogy to the bilateral symmetry of the human body—structured the basic forces in nature. When it was theorized that the weak interactive force violated left-right symmetry, Pauli offered to bet a very high sum, declaring "I do not believe that." After the new thesis was proved, Pauli offered a restatement: "I am shocked not so much by the fact that the Lord prefers the left hand as by the fact that he still appears to be left-right symmetric when he expresses himself strongly. . . . Why are strong

[54] Jaynes 1990, p. 50.
[55] Steiner 1969, pp. 44–45.
[56] Jung 1943, par. 768.
[57] See Letter 44.

interactions right-and left-symmetric?"[58] Twelve years after Pauli's Nobel Prize, the 1957 award went to Tsung-Dao Lee and Chen Ning Yang for demonstrating that if the universe were reflected in a mirror, the behavior of weak interaction would not be the same. Pauli was also disappointed when his symmetry-based unified theory of elementary particles was not well received. Pauli withdrew, perhaps because of his disappointment or perhaps because of illness, and in 1958, this man who spoke of the "radioactivity" of the self died of rapidly advancing cancer.

Despite the fundamental difference between physics and psychology, in their meeting of the minds Jung and Pauli reconnected the meditative and scientific strands in serious alchemy, as well as the complementarities that emerged from William James's philosophy. They linked ancient questions and modern theories and experiments, the interior search of reflective depth psychology and the outward gaze of scientific inquiry.

Von Franz believes that "if we try all the same to meet, it is for the reason that in its fringes, where psychology reaches over to other fields of science, there should exist—if possible—no fundamental contradictions. A psychology which does not keep pace with the findings of other sciences seems to me no good."[59] We may easily be carried away by broad analogy, but despite the seemingly magical in mythologies and the peculiarities of the alchemical opus, their intuitions about the origins and potential of matter for transmutation have been realized with elaborate technology. "The scorn of late nineteenth century scientists for the alchemists was noticeably absent after the discovery that transmutation of elements does take place in nature."[60]

But even a nonscientific mind, "sunk" like Jung's, by the mathematics of contemporary science, may find resonance with the fluidity of process described in modern biology, brain research, chemistry, astronomy, and theoretical physics. What are some of the "findings" with which to "keep pace"?

The alchemists imagined progressive integration through conjunctions between pairs that were both like and unlike; a current thesis holds that "matter and antimatter are not mirror images of each other but instead exhibit a subtle asymmetry."[61] Scientists posit that without asymmetry, the universe would not exist: Had the big bang spawned precisely the same amounts of matter and antimatter, they would have annihilated each other on contact. Aristotle and western alchemists posited four elements: earth, air, fire, and water: today, scientists refer to four forces: gravity, electromagnetism, the strong force that keeps protons and neutrons gripped, and the weak force from which comes nuclear decay (electromagnetism and the weak force join in the electro-weak force). The alchemists mused on feminine salts and masculine sulphurs connected by mercurial sparks; modern

[58] Stewart and Golubitsky 1992, p. 181.
[59] von Franz 1992, p. 288.
[60] Crosland 1992, p. 32.
[61] Horgan 1994, p. 103.

theories refer to the electro-weak and quantum-chromodynamics of the strong force, made up of quarks (a term taken by another Nobel physicist, Murray Gell-Mann, from Joyce's *Finnegans Wake*), held together with "gluons." Called a "gauge theory," this is posited on symmetry, for which many particle physicists is "the epitome of truth and beauty." The alchemists imagined a goal of achieved integration that would mimic the original unity. In science's search for fundamental unity, some scientists attempt to conjoin forces plus gravity in quantum-gravity theories that would finally fuse quantum mechanics and general relativity.

Scientists posit that for every particle known to exist there is a complementary particle yet to be discovered. In the revolutionary theory of supersymmetry, fermions (particles which constitute matter) and bosons (which transmit forces) are seen to share deep symmetries. Thus, each known particle may have a relatively massive supersymmetrical partner (or "sparticle") and is dependent on "the coupling constants" that are measures of strength of the forces. "In supergravity theory, particles that transmit gravity, known as gravitons, have supersymmetrical partners called gravitinos."[62]

Supercolliders necessary to achieve a unified theory would need to be one thousand light-years circumference (the solar system being one light-day around) and thus would be immeasurably larger vessels than the alchemical retorts. And yet the modern terms in the search for the *prima materia* are "quaintly" akin to the alchemical language of synthesis in descriptions of reunions of coupled energies imagined as sun and moon, king and queen, dog and bitch.

Alchemists linked the levels of reality through the doctrine of "signatures" and through imagined correspondences. Analysts peer into the psyche for hidden connections between forms of experience, behavior, and relativizing links between conscious and unconscious. Physicists fantasize about superstrings, which in a sense encircle the universe and generate all forces in nature—gravity strings pictured as inhabiting twenty-six dimensions. Their vibrations are said to give rise to quantum properties that "can merge and separate, like interacting particles; their geometric nature lends itself to being made relativistic."[63] Alchemists rivaled each other to transform lesser metals into gold and to approach the understanding of the "unus mundus" through their meditations on the opposites in powerful attraction and repulsion. As I write in the summer of 1999, competing, powerful accelerators are in a hot and tight race to find "The God Particle," the Higgs boson which as "the universal giver of heft" is believed to endow all the constituents of matter with mass. The Higgs would be very heavy for a boson, but it could as light as 109 billion electron-volts—somewhat less than the weight of an atom of silver. Its creation requires a collision of two

[62] Ibid., p. 102.

[63] Stewart and Golubitsky 1992, p. 255.

ordinary particles; through multiple colliding particles, the Higgs mechanism might explain the specific masses of individual particles.

From 1946 on, Jung called the transconscious archetype psychoid—that is, transpsychic insofar as "not purely psychic but just as much physical in nature."[64] They contain all the collective patterns for conceptualizing human experience, including those "phenomenological contents of the mind" that Jung recognized as exhibiting certain *apparently* lawful archetypal patterns.

In his thesis of "frozen accidents," the complexity theorist and Nobel physicist Murray Gell-Mann, discoverer of quarks, the elementary particles of the atomic nucleus, approaches in the physical world what Jung broached through his apparently lawful psychic archetypes.

> The effective complexity of the universe is . . . a concise description of its regularities. . . . [It] receives only a small contribution from the fundamental laws. The rest comes from the numerous regularities resulting from "frozen accidents." Those are chance events of which the particular outcomes have a multiplicity of long-term consequences, all related by their common ancestry.[65]

Gell-Mann argues:

> The consequences of some such accidents can be far-reaching. The character of the whole universe was affected by accidents occurring near the beginning of its expansion. . . . The long-term consequences of such an event may take on the character of a law, at any but the most fundamental level. A law of geology, biology, or human psychology may stem from one or more amplified quantum events, each of which could have turned out differently.[66]

Jungians see archetypes as "contaminated" by and inseparable from one another. Nonsymmetry physicists speak of cellular automata, in which the state of each cell is determined by the state of its immediate neighbors, or of "loop-space theory."[67] The physicist David Bohm speaks of an unknowable holomovement or flow of an explicate and implicate order, in which wave functions are physical, like classical force fields, guiding particles. In his theory, the positions of all particles and the quantum-mechanical wave function can be calculated with certainty, whereas the older theory is nondeterministic.[68] Some theorists find Bohm's scheme more approachable than the "superpositions" of quantum mechanics, which deal with mysteries as nonfacts and in which the wave functions that represent the states of physical systems are mathematical objects.[69] The nonlinear dynamics of

[64] Ibid., p. 102, and Jaffé 1972, p. 7.
[65] Gell-Mann 1995, p. 134.
[66] Ibid.
[67] Horgan 1994, p. 104.
[68] von Franz 1992, pp. 251–52.
[69] Albert 1994, pp. 58–67.

so-called chaos theory—in which deterministic causes can have random effects and which deals with irregularities and apparent absences of pattern—offers its own seductive and compelling analogies.

As I write, the number of elements of the periodic table named and "created" is approaching 120. Physicists have also found Gell-Mann's so-called top quark, the last of six fundamental building blocks of nature. Like the alchemist's elusive scintillas and Goethe's shattered homunculus of Faust's "Aegean Festival," they are "captured" for only a fraction of a second.

Physicists and astrophysicists are gaining on the precise nature of Pauli's elusive neutrinos. Like the arcane mercurial sparks, as they scarcely interact with normal matter they are detected only in high-precision accelerators or traced with a powerful telescope trained on distant galaxies. Only in 1999, sixty-seven years after Pauli insisted on their reality, has their presence and mass been determined, in Japan. As an alchemist said, "There are fiery sparks of the World-Soul, that is, of the light of nature, dispersed or scattered in and through the fabric of the great world into all the fruits of the elements everywhere."

Both as an inner process and as an outer endeavor, alchemy was focused on reachieving the unus mundus through the mysterious conjunctions of the soul-spirit-body with the world as it was at the beginning of time. One alchemist asked, "Why speak ye of the manifold matter? The substance of natural things is one, and of one nature that which conquers all." Modern physics and astronomy are not concerned with the introverted or the nonmaterial spectrum. They are in quest of theories that "hold out the promise of illuminating the fiery birth of the universe, when a single supreme force may have briefly reigned, [and] . . . are also known as theories of everything."[70] One alchemist wrote, "The sparks were already in the chaos, the prima materia at the beginning of the world."

Pauli pursued the symmetries. The Chinese spoke of the yin and the Receptive in the Tao. The ancient Egyptians honored the goddess Maat as an extended grid against which all could be measured and balanced. The Navajo imagine Changing Woman, who, with her bundles, re-creates creation in space-time. Modern mathematicians write, "Yes, God is a geometer. But never forget: She's better at it than we are."[71]

Heisenberg noted Pauli's reference to the "theologians to whom I stand in the archetypal relation of a hostile brother," but he nonetheless continued "in his wrestlings with the One." Pauli declared that if neither rationalism nor mysticism was powerful enough,

> nothing else remains but to expose oneself in one way or another to these intensified oppositions and their conflicts. Precisely by doing so, the inquirer can also more consciously tread an inner path to salvation. . . . I

[70] Horgan 1994, pp. 97–98.

[71] Stewart and Golubitsky 1992, p. 269.

consider the ambition of overcoming opposites, including also a synthesis embracing both rational understanding and the mystical experience of unity, to be the mythos, spoken or unspoken, of our present day and age.[72]

Connection and Divergence

Pauli was concerned with science, philosophy, and religion throughout his life. Speaking from his doubt that human societies could live with sharp disinctions between science and faith, the young Pauli believed that "it's all bound to end in tears. . . . The central order is part of the subjective as well as the objective realm, and this strikes me as being a far better starting point."[73] A few months before he died, Pauli told the Gnostic scholar Gilles Quispel that while he could accept "the God of the Gnostics. . . . I could never accept the existence of a personal God. No such Being could possibly endure the suffering of humanity." According to Quispel, Pauli, in searching for a meaning to his life while confronting his death, came to reassert his Jewish tradition.[74] Perhaps Pauli's need for symmetry did not allow him to embrace a reality of subtle asymmetry or broken symmetries. But Pauli still stands as a central figure in the history of science and, through his partnership with Jung, in the history of psychology. As a modern poet writes:

> I drag myself too often to those whose work it is
> to calm those devastations of the surface
> which are, like coincidences,
> the visible traces of untraceable principles.
> A physicist said that, not a medium.[75]

Jung did not repudiate the wisdom accumulated before the Age of Enlightenment, nor see psychology as a field unto itself, derived only from the observation of personal symptom and behavior. He looked back to tribal myth, to classical mythology, to gnosticism, to alchemy, for intuitive theories of everything. He looked out to physiology and chemistry, mathematics and physics. He found a place where his psyche was at rest, in the "grand unified theory" of the unus mundus.

Pauli was also drawn to this unity but seemed not to have found psychic peace. Pauli did not expect that the concepts of the unconscious would "go on developing within the narrow frame of their therapeutic applications, but that their merging with the general current of science in investigating the phenomena of life is of paramount importance for them."[76]

[72] Heisenberg 1974, pp. 37–38.
[73] Heisenberg 1971, pp. 83–84.
[74] Pagels 1988, p. 326, as cited in Rossi 1989, pp. 7–8.
[75] Levine 1994, p. 70.
[76] Jaffé 1972, p. 43.

According to von Franz, Pauli concluded "Jungian psychology should be transformed into a philosophy."[77] Here Jung and Pauli diverged. Jung saw psychic libido as related to mana, "meaning," and the feeling function. This is "the specific value but also the limitation of psychology. . . . The vagueness of meaning forces us to go beyond science . . . to myth. That inevitably leads to antinomies and an obscuring of scientific clarity . . . because we have to deal with the human individual as a whole." Ultimately, then, "the meaningful but rather vague language of myth is in [Jung's] view more appropriate to the description of psychological facts."[78] Correspondingly, David Bohm believed that "images are important . . . a key bridge between the older emotional brain and the more intellectual neocortex."[79]

In their attempts to link emotion and intellect, intuition and perception, image and concept, Jung and Pauli placed themselves in the long line of those humanistic and speculative philosophers and those reflective and protoscientific experimenters who imagined underlying interconnections—of "sympathies," "correspondences," "signatures"—among the various constituents of the universe. They would comfortably participate today in the discourses among scientists of many traditions.

Pauli and Jung—despite their asymmetry in the realm of the feeling connection to matters psychological—shared a sensibility both with theorists at the frontier and the alchemists of old. Jung valued the voluntary sacrifice for the sake of personal transformation that alchemy had in common with the Mysteries. Pauli recognized that, in contradistinction to alchemy, the observer in physics is not himself transformed, because "the 'gift of sacrificing' is not a part of himself, but a portion of the external world." But now neuroscientists such as Gerard Edelman further the psychological and existential queries about the observers: Are they things; why can they refer to and categorize other things; and what occurs "when we ourselves observe observers":

> Einsteinian and Heisenbergian observers, while embedded in their own measurements, are still psychologically transparent. Their consciousness and motives do not have to be taken into account to practice physics. The mind remains well removed from nature.[80]

He proposes that

> matter itself may be regarded as arising from processes of energy exchange. In modern science, matter has been reconceived in terms of processes; mind has not been reconceived as a special form of matter. That mind is a special kind of process depending on special arrangements of matter is the fundamental position I will take.[81]

[77] Sieg 1992, p. 56. [78] von Franz 1992, p. 289. [79] Bohm 1988, p. 26.
[80] Edelman 1992, p. 11. [81] Ibid., p. 6.

Mathematicians ask whether symmetries are intrinsic patterns of nature or artifacts of human perception. And they answer that the human brain, as part of nature, obeys nature's laws and thus may have evolved to detect the patterns that are "really present."[82]

One physicist believes that "everyday we need new approaches to build new images of nature." Yet another states, "Converting science into liturgy would be depressing." Meanwhile, the "study of the history of science does not require a moral justification, but if it did, it might be to teach humility."[83] And a contemporary Nobel laureate notes that even "quantum field theory is not secure. . . . We are not likely to know the right answers until we are close to knowing the answers."[84] Jung adds his prognosis, "What demands psychology will make on the other natural sciences, and on physics in particular, only the future can tell."[85]

The mathematical "way out" of the obstacles to Pauli's symmetry-based theory, "which the disparity among the four forces presents[,] has to do with interactions taking place at higher energies which change the strength and ranges of the forces." The "way out" of the dilemma about the interactions between matter and psyche at higher energies requires the persistence, the awareness, and the wonder about invisible patterns shared by Jung and Pauli with the alchemists of old and the scientists at the frontier.

Jung once wrote that when future generations read our psychology, they would wonder if we knew what we meant. He and Pauli both gloried in the possibilities of the human mind and also remained aware that all human understanding must remain open to question. They might well speak the lines from a contemporary English play, *Copenhagen*, in which the character of Niels Bohr says to the character of Werner Heisenberg:

> We put man back at the centre of the universe. . . . It starts with Einstein. He shows that measurement, on which the whole impossibility of science depends—measurement . . . [is] a human act, carried out from a specific point of view in time and space, from the one particular viewpoint of a possible observer. Then, here in Copenhagen in those three years in the mid-twenties we discover that there is no precisely determinable objective universe. That the universe exists only as a series of approximations. Only within the limits determined by our relationship with it. Only through the understanding lodged inside the human head.[86]

[82] Stewart and Golubitsky 1992, p. 259.
[83] Crosland 1992, p. 32.
[84] Weinberg 1994, p. 173.
[85] Jung 1955–1956, 14 par. 775.
[86] Frayn 1998, pp. 73–74.

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