

---

**The Complementarity of Consciousness**

Robert G. Jahn

Princeton Engineering Anomalies Research  
School of Engineering and Applied Science  
Princeton University  
Princeton, NJ 08544-5263

Technical Note PEAR 91006  
December 1991

## The Complementarity of Consciousness\*

Robert G. Jahn

### Abstract

The concept of complementarity, originally proposed by Bohr in a microphysical context, and subsequently extended by himself, Heisenberg and Pauli to encompass subjective as well as objective dimensions of human experience, can be further expanded to apply to many common attitudes of human consciousness. At issue is the replacement of strict polar opposition of superficially antithetical consciousness capacities, such as analysis and synthesis, logic and intuition, or doing and being, by more generous conjugation that allows the pairs to operate in constructive triangulation and harmony. In this format, the physical principle of uncertainty also acquires metaphoric relevance in limiting the attainable sharpness of specification of any consciousness complements, and may serve to define their optimum balance in establishing reality. These principles thus lend themselves to representation of wave-like vs. particle-like operations of consciousness; to trade-offs between rigor and ambience in consciousness research; to generic masculine/feminine reinforcement; and to the interplay of science and spirit in any creative enterprise.

\*Revised version of a presentation to the L. E. Rhine Centenary Conference, "Cultivating Consciousness for Enhancing Human Potential, Wellness, and Healing," November 8 - 10, 1991.

## I. Bohr's Complementarity

Physical mechanics, in both classical and quantum formalisms, makes extensive use of certain paired quantities usually termed "conjugates" or "complements." Each member of any conjugate pair represents some fundamental property of the process or system described and is canonically independent of the other, yet both are jointly required to specify the situation completely. The most common examples of such conjugate quantities in physics are the components of linear momentum and their corresponding positions; the components of angular momentum and their corresponding angles, and energy and time. Such pairs may be regarded as conceptual coordinates defining two-dimensional spaces wherein the processes, systems, or objects may be mapped as trajectories, and various conservation and quantization rules apply to the integrals over these paths.

Early in the development of quantum mechanics, Niels Bohr, in an attempt to relieve the philosophical paradox of the wave/particle duality and other enigmas of modern physics, proposed a striking generalization of the physical concept of complementarity into frankly metaphysical dimensions. In his own words:

"... we must indeed remember that the nature of our consciousness brings about a complementary relationship, in all domains of knowledge, between the analysis of a concept and its immediate application ... in associating the psychical and physical aspects of existence, we are concerned with a special relationship of complementarity

which it is not possible thoroughly to understand by one-sided application either of physical or of psychological laws ... only a renunciation in this respect will enable us to comprehend ... that harmony which is experienced as free will, and analyzed in terms of causality. ...

"The real problem is: How can that part of reality which begins with consciousness be combined with those parts that are treated in physics and chemistry? ... Here we obviously have a genuine case of complementarity..."(1)

Werner Heisenberg, author of the "uncertainty principle," endorsed Bohr's extrapolation in similar terms:

"We realize that the situation of complementarity is not confined to the atomic world alone; we meet it when we reflect about a decision and the motives for our decision or when we have the choice between enjoying music and analyzing its structure..."(2)

and they were joined by Wolfgang Pauli, author of the "exclusion principle" and collaborator with Carl Jung in the latter's studies of synchronicity:

"On the one hand, the idea of complementarity in modern physics has demonstrated to us, in a new kind of synthesis, that the contradiction in the applications of old contrasting conceptions (such as particle and wave) is only apparent; on the other hand, the employability of old alchemical ideas in the psychology of Jung points to a deeper unit of psychical and physical occurrences. To us ... the only acceptable point of view appears to 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. It would be most satisfactory of all if physics and psyche could be seen as complementary aspects of the same reality."<sup>(3)</sup>

The scale of revision in conceptual and operational perspective predicated by the Bohr/Heisenberg/Pauli points of view should not be undervalued. Classical philosophy until that time had been dominated by Cartesian duality, and was largely content with absolute and polar measures; it spoke of thesis and antithesis, of dialectic tension, of "self" and "not-self." Common conceptualization likewise tended to "either-or" divisions. Now, from a hard scientific sector, it was suddenly proposed that some of these sharp dichotomies could be replaced by more subtle and sophisticated complementarities, wherein arbitrary proportions of superficially disparate properties might be profitably combined to deal with given situations. And indeed, considerable philosophical elegance, as well as pragmatic benefit, can thereby be obtained, not least of all in the bemusing domains of consciousness anomalies that we address in our research.

## II. Consciousness Complementarity

To develop this theme, we extend Bohr's concept to propose that a great many attitudes of consciousness can be complementary to one another in much this same sense. Grouped in appropriate pairs, such attitudes entail the same orthogonal irreducibility, yet can provide the same conceptual reinforcement, as the conjugate physical quantities, and can similarly serve

to define consciousness operational spaces. With no claim to completeness, an introductory list of such "consciousness conjugates" might include:

observation/participation  
analysis/synthesis  
pragmaticism/aestheticism  
structure/function  
goal/process  
logic/intuition  
sincerity/humor  
left brain/right brain  
objectivity/subjectivity  
assertion/reception  
doing/being

Note that in each case a somewhat more tangible or definable characteristic is teamed with a more holistic or diffuse one, but that the two are not essentially competitive; rather, they can be combined in arbitrary proportions as befits the situation: participation in an activity need not preclude its observation, or visa versa; detailed, logical, structural analysis need not be antithetical to combination or synthesis; the pragmatic and aesthetic aspects of an occupation need not stand in contradiction. In fact, some of the most satisfying creations are those in which the pragmatics and the aesthetics fully complement one another, as in modern aircraft, a beautiful bridge, a piece of furniture, or a well designed college curriculum. The same obtains for the examples that Bohr, Heisenberg, and Pauli originally offered: causality/freewill; decision/motive; quantitative/qualitative; physics/psyche.

### III. The Consciousness Uncertainty Principle

In its physical context, Heisenberg's uncertainty principle constrains the precision of simultaneous specification of any two physical conjugates to the order of Planck's constant. We might reasonably ask whether a similar uncertainty may also pertain to the consciousness conjugates suggested above, i.e. whether excessive circumscription of one of a pair of consciousness complements inevitably blurs definition of the other. The list we have compounded would indeed seem to support that suspicion: excessively detailed attention to any of the analytical/structural/objective pair members does tend to limit appreciation of the corresponding aesthetic/holistic/subjective complement; conversely, excessive preoccupation with the "softer" aspects can compromise technical integrity or precision. In fact, the consciousness uncertainty principle may define the optimum balance between the conjugates-- that configuration where the relative degree of attention to each aspect yields the best possible product. Think, for example, of the consummate actor, athlete, or artist who combines technical mastery of his tools with subjective immersion in his performance, without allowing either to distort the other. Or reflect on our propensity to balance disciplined techniques for performing mundane tasks with some degree of satisfaction or joy in the immersion in them. The familiar adage "all in moderation" may be just another expression of this consciousness uncertainty principle -- a caution not to obscure any of life's dimensions by excessive attention to its complement.

#### IV. The Wave/Particle Complementarity

Of the many specific ramifications of the consciousness complementarity concept we might ponder in more detail, the wave/particle enigma that prompted Bohr's original proposition remains one of the most profound and universal. From his beginnings, man has clearly possessed the capacity to think in both particulate and wavelike terms: allusions to sharply localized objects and to broadly diffuse undulatory effects share prominence in the art, language, and science of all cultures and all ages. Yet, over much of the history of physical science, philosophical quarrels have persisted over whether such phenomena as light, sound, and atomic scale processes are more basically particulate or wavelike in character. To this day, experiments continue to be performed to demonstrate that either modality can be convincingly demonstrated under appropriate circumstances of observation. Note that Pauli alluded to this dilemma in his quotation above, in essence suggesting that waves and particles bear all the requisites of complementary representations of reality, and thus may be epistemologically irreducible.

James Jeans drove this issue one layer deeper by suggesting:

"There is no longer a dualism of mind and matter, but of waves and particles; these seem to be the direct, although almost unrecognizable, descendants of the older mind and matter, the waves replacing mind and the particles matter. ... It seems at least conceivable that what is true of perceived objects may also be true of perceiving minds; just as there are wave-pictures for light and electricity, so there may be a corresponding picture for consciousness."<sup>(4)</sup>



What Jeans appears to be implying is that it may not be the physical world in any abstract sense that presents these wave/particle complementarities, but rather the perspective of the consciousness observing it. And why not? Is it unreasonable to suggest that the consciousness that invokes wave/particle dualities to help it represent abstract physical phenomena might find the same tactic useful when trying to represent itself? May consciousness not find itself behaving like a particle in some situations, and like a wave in others?

Considerable explicative benefit can follow from this presumption, not least of all in the interpretation of consciousness-related anomalies. So long as a particulate model of consciousness is retained, i.e., an entity sharply localized in space and time, effects like remote influence on physical processes or the acquisition of remote information as observed in our experiments must remain inexplicably anomalous. But if consciousness is itself permitted the same wave/particle complementarity it has conceded to numerous physical processes, such events become more tractable. For example, a wave-like consciousness could invoke various diffraction, interference, and remote penetration abilities to achieve in normal fashion the anomalies of its particulate counterpart. It would also acquire the capacity to resonate, and to bond, with other wave-like consciousnesses, and with other wave-mechanical processes in the physical world, and thereby to achieve a new spectrum of experience.

#### V. Complementarity in Consciousness Research

There are two well demonstrated routes to failure in research on anomalous consciousness phenomena: sloppy research and sterile research. The former, which provides ample and legitimate targets for critical and skeptical

colleagues, is characterized by weakness of protocol, equipment, analysis, or deduction that precludes credible advances in data accumulation and comprehension, and clearly must be eschewed. In the latter category, however, there also lies a substantial body of failed research that has been pursued with such slavish rigor that the effects under study have been totally anesthetized. The simplest illustration of this mode of failure might be with reference to those less controversial, yet closely related capacities of human consciousness we call "creativity." If one were to undertake scientific study of creative processes, one would clearly need to respect the vital role of the subjective environment. For example, one would hardly attempt to encumber a great composer with EEG electrodes, place him under bright lights, surround him with carping critics, and then ask him to compose a symphony. Nor would one attempt to solve a difficult mathematical problem in a steel foundry, or to provide emotional counseling in a hardware store. In each case, the aesthetic ambience and the subjective comfort are critical factors to emergence of the desired effects. Just so with consciousness research: to succeed, sophistication of equipment and rigor of control and analysis must be balanced with comfort of protocol, laboratory ambience, and staff attitudes in a complementarity that allow the phenomena to bloom naturally, while still presenting themselves for verification and analysis. Failure of this balance in either direction will inevitably invalidate, or suffocate, the results.

#### VI. Masculine/Feminine Complementarity

Perhaps the most subtle and least understood example of consciousness complementarity is that between those primordial characteristics of human behavior, expression, and values we inadequately catalogue as "masculine" and

"feminine." When posed in polar opposition, whether within a single personality, or in the context of the ubiquitous interactions between the male and female sexes, the failures of this interface are legion, legendary, and immensely destructive, both personally and socially. Yet, when deployed in constructive complementarity, the masculine/feminine integration within the individual can enable the highest creativity and personal satisfaction, and in the male/female partnership can generate some of the highest accomplishments, profoundest insights, and most beautiful resonances of human existence. In this form, it is probably the species' most powerful resource for spiritual as well as physical survival and evolution.

Techniques for metaphorical representation of the masculine/feminine complementarity in terms of the quantum mechanical spin properties of interacting physical systems have been developed and applied to our experimental designs<sup>(5,6,7)</sup>. In this format, assertive/receptive features may also be attributed to the experimental devices or physical processes employed in the laboratory, so that the proper pairing of these aspects of the operator's attitude or style with the perceived characteristics of the experiment becomes an important factor in the establishment of the resonant operator/machine bonds that seem to enable the anomalous results. A growing body of gender-related experimental results have been emerging to support these predictions<sup>(8)</sup>, and such considerations now influence the design of new studies.

#### VII. The Complementarity of Science and Spirit

The powerful philosophical extension of the principle of complementarity into the domain of human consciousness that Bohr first proposed propagates

its roots even more deeply into the metaphysical foundations of modern science than even he may have imagined. In the ultimate sense of the terms, science, in its neoclassical format, and mysticism, in its loftiest interpretation, are themselves two complementary ethics, fundamentally united by the yearning of human consciousness for understanding of its relationship to the cosmos and for participation in the creation of reality, yet sharply distinguished by the tactical approaches employed in pursuing these goals. Thus science, launching itself from the primordial distinction of self from non-self implicit in its Aristotelian and Judeo-Christian heritage, utilizes the ability of consciousness to distinguish, to isolate, and to represent elements of reality by objective observation and dispassionate logic. Mysticism, in contrast, invokes consciousness strategies of association and assimilation to achieve a unity of self and not-self in its search for subjective identification with the mechanics of creation. Failure to recognize the essential complementarity between these objective and subjective capacities of consciousness will inevitably frustrate any research that attempts to comprehend them, and may well confound scientific investigations into many similarly subtle physical phenomena. In fact, this same failure lies at the heart of the generic philosophical impasse that is confounding our contemporary human condition. Albert Einstein stated the problem succinctly several decades ago:

"Science without religion is lame. Religion without science is blind."(9)

"The cosmic religious experience is the strongest and noblest mainstream of scientific research."(10)

But Einstein did not venture to propose a mechanics for integration of these two superficially contradictory modalities, perhaps because such resolution can only be obtained through the very concept that he long rejected -- the concept of complementarity.

In the interplay of intellect and spirit we are dealing with the ultimate conjugate perspectives whereby consciousness triangulates its experience. The issue is whether these will be deployed in mutually encumbering contradiction, or in mutually fulfilling complementarity. The desirability of the latter, of course, has long been recognized and propounded in various abstract contexts, but has never been satisfactorily formulated in practical terms. Clearly, we do not have an explicit formula, even now. But we can now rigorously demonstrate, on the laboratory bench, and to some extent in our corresponding models, that human will, volition, desire, attention -- call it what you wish -- deployed in self-surrendering resonance with even a simple physical system or process, can significantly affect its behavior, and that the same deployment of human will in resonance with another human consciousness can condition the mutual reality to a significant extent.

The challenge ahead of us is to expand and to extend such data bases and such models into many other scholarly sectors, from whence to weave a new fabric of complementary science that respects and utilizes subjective qualities as much as objective quantities, aesthetic sensitivities as much as analytic techniques, and mystical insights as much as tangible experiences. Clearly we face monumental obstacles of conceptualization, vocabulary, and measurability on our road to such a holistic science. But we should be sustained in this effort by the recognition that science of any era has always been no more than a particularly disciplined form of human activity:

scientific vocabulary has always been only a subset of human linguistics; scientific observation and scientific conceptualization have always drawn by metaphor from broader and less tangible human experience; and scientific logic has always been just a special form of basic human reasoning. It is not unfounded, therefore, to hope that the primordial consciousness that has so brilliantly conceived and refined its science of the objective, and that has at the same time so fully experienced and celebrated the mystical dimensions of its life, can now finally integrate these complementary perspectives into a super-science of the whole, wherein consciousness will stand as full partner with its cosmos in the establishment of reality.

#### Acknowledgements

The Princeton Engineering Anomalies Research program is supported by grants from the Fetzer Institute, the McDonnell Foundation, the Ohrstrom Foundation, and by other private donations.

## References

1. Bohr, N. (1961). Atomic Theory and the Description of Nature, Cambridge: The University Press, pp. 20, 24, 115.
2. Heisenberg, W. (1958). Physics and Philosophy: The Revolution in Modern Physics, New York: Harper & Row, Harper Torchbooks, p.179.
3. Pauli, W., "The Influence of Archetypal Ideas on the Scientific Theories of Kepler," in C. G. Jung and W. Pauli, The Interpretation of Nature and Psyche, New York: Pantheon Books, Bollingen Series L1, (1955), pp. 208, 210.
4. Jeans, J. (1943). Physics and Philosophy, Cambridge: The University Press, p. 204.
5. Jahn, R., Dunne, B. (1987). Margins of Reality: The Role of Consciousness in the Physical World, New York: Harcourt Brace Jovanovich.
6. Jahn, R., & Dunne, B. (1986). "On the quantum mechanics of consciousness, with application to anomalous phenomena." Foundations of Physics, 16, pp. 721-772.
7. Jahn, R., & Dunne, B. (1984a). On the Quantum Mechanics of Consciousness, with Application to Anomalous Phenomena (Technical Note PEAR 84001), and (1984b) Appendix B: Collected Thoughts on the Role of Consciousness in the Physical Representation of Reality (Technical Note PEAR 84001-B). Princeton Engineering Anomalies Research, Princeton University, School of Engineering/Applied Science.
8. Dunne, B. (1991). Co-Operator Experiments with an REG Device. (Technical Note PEAR 91005). Princeton Engineering Anomalies Research, Princeton University, School of Engineering/Applied Science.
9. Einstein, A. (1956). Out of My Later Years, rev. reprint ed. Secaucus, NJ: The Citadel Press, p. 26.
10. Einstein, A. (1979). (In L. Barnett, The Universe and Dr. Einstein, rev. ed. New York: William Morrow Bantam Books, p. 108).