"ANECDOTED 'QUANTUM PSYCHOLOGY EXCERPT'" FROM 4/27/84 LETTER FROM OSHINS TO ORLOV

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"...This quantum approach suggests looking at symmetry transformations upon the lattices [of subspaces of Hilbert space] as an extremely efficient means for coding regularities in the physical environment. It also helps geometric intuitions about structures that underlay logics and languages. I will now mention some of the other psychological work that I have been modeling through this approach (and will try to select a few reprints to forward to you):

There is strong experimental support due to Shepard, et. al.[1], that, in mentally comparing differentially oriented, asymmetrical geometric objects, the time required to accurately discriminate whether or not a second object is a mirror image or the identical object is linearly proportional to the relative angular orientation, thereby, indicating that rotations of mental representations take place in these comparisons. The quantum logic approach would generalize such rotations by employing the more fundamental covering group SU(2,C). (I am also trying to look at Shepard's general theory of transformations of internal representations[2] as unitary transformations on induced representations.)

We know that other cultures perform meditative exercises, such as the Philippine folk dance Binasuan or "wine dance"[3] and the Chinese Pa Kua Chang[4], that employ the double coverings and the orientation-entanglement relationship that differentiates between the unitary and the orthogonal symmetries. (You can do this by rotating your arms while keeping your palms facing upward. The double covering is effected by rotation above and below the elbow.) The quantum symmetry necessitate[s] the coding of an impenetrable region of space (solid object in a 3-dimensional physical space), which may well have evolutionary importance.

I think that it would be very interesting to study...motion and attention during some of these "moving meditations" by using an angular basis such as spherical harmonics or Bessel functions. One could look for normal coordinates and for ignorable coordinates. Perhaps the mind impletes motion by integrating the structure constant[s] of the Lie algebra. This might provide an attractive way to classify motion. An interesting, similar study was performed in the USSR by Bernstein[5] who made fourier decompositions of motion and was able to predict future movement "to an accuracy of within a few millimeters" with only the first 3 or 4 low harmonics!

When part of the brain is destroyed, the individual does not lose a "chunk" of memory but does lose a more global resolution. In order to explain such observed phenomena, Pribram and others have put forth an extremely clever "holographic" model of memory and perception. The interpretation is that the information is encoded in a Fourrier transform mode (square-root of inversion?)[6], whereby a truncated transformed distribution would display such "graininess" upon retransformation.

From our quantum point of view, one could do the same but have coherence in an L-2 Hilbert space, instead of in the classical L-1 linearly additive, state space [of rays][7]. As you indicate in eq. 25 of "The Wave Logic...,"[8] one would then obtain the standard interference patterns which can discriminate between the two models. It would be important to elaborate on how you would actually do the experiment. In the quantum formalism this map from positional information into "spacial frequency" provides "the generator of translations" and is equivalent to Galelian relativity[9] (Jauch) but not in the classical formalism such as a hologram[10].

Von Bekesey[11] has demonstrated a phenomenon of neuronal superposition such that appropriately timed incoming sense data is experienced as though it came from a location where there is no source, such as the stimulation of two fingers allowing for sensation as if from a location between both of them. Although I am not aware of any interference data which would support my interpretation, I believe that such a projected state would be a quantum coherent superposition maintaining a unit information ray because a classical vector addition/superpostion would be experienced as amplified, which I assume does not occur[12].

By applying an alternating direct current to a finger and using a SQUID (Superconducting Quantum Interference Device)[13], Williamson[, Kaufman,] and Brenner[14] have been able to localize magnetic activity sites on the opposite skull. Switching polarity reverses the magnetic field direction. Current applied to a different finger systematically displaces the exit and entry points of the magnetic activity. Similarly, when performed on the other arm, the activity was found on the other side of the skull. This magnetic activity exhibits a plane symmetry between the two hemispheres and resembles a dipole current loop[15]. [They also find that the neuromagnetic latency increases with decreasing spacial frequency in visual neuromagnetic evoked response. In some subjects there appears to be an abnormally long latency which might indicate a cognitive/perceptual information processing impairment?]

One can also show in quantum theory that in order to have a negative coded in the information content of physical signals requires a synchronization between the preparation and the measurement of the information signals (Finkelstein)[16]. To Freud[17] the fundamental attribute of the unconscious is that there is an absense of negation. Negation plays three significant roles: (1) necessary for conscious, (2) necessary for mature judgement, and (3) necessary to form boundary between self and other. I have been trying to look at possible roles for synchronization as a necessary prerequisite for consciousness. If an inversion operation is responsible for a quantum negative, perhaps there is symmetry breaking (with multipole moments?) in schizophrenics that would indicate a desynchronization, perhaps across the corpus collosum.

There is some empirical support indicating local randomized synaptic firings due to a multistable oscillation in dopamine receptors in schizophrenics[18]. This might be responsible for problems in forming stable inhibitory hyperpolarizations across the synapses. If one couples asystem having angular information (eg. spinors) to a random system having no information, the composite system becomes partly depolarized. Thus a relative randomization would degrade the information content. I suspect there will be a global effect. As indicated earlier, I believe that inversion processes may underly the brains mechanism for mental Fourier transforms[19], perhaps by phase encodement across the medial plane. SQUID techniques might indicate intra-hemispheric neuromagnetic coherences while simultaneously stimulating opposing limbs, as in von Bekesy's experiment, or say between an olfactory and visual center while someone is having an hallucinatory vison of an odor.

I currently believe that consciouness performs such synchronization processes[20], thereby compactifying the logic. This would allow for negation and for the construction of finite subcoverings to be used in the hierarchical structure of psychological "plans." The capacity to be conscious might be the result from a transition between the two types of nondistributive lattices (for which I've drawn Hasse diagrams above). Notice that the 3rd lattice appears to be equivocating parts and wholes on the right side in aggregating the concepts. This may well represent the kind of mixing of logical level in the double-bind approach. Instead of an orthocomplement, this type of lattice only admits a "relative complement." A compactification into the other nondistributive (modular) lattice (which occurs for finite unitary representations) may provide for the metricity of the probability measure defined on the lattice.

I believe that our quantum logic approach to psychology provides an improved representational framework for looking at the mind than traditional, classical points of view. I think it will come to be accepted in time because it embodies a richer realization of experience, despite the considerable resistance that it will have. When this occurs, I believe that science will be considerably in your debt, as I am, for the marvelous insights that you have given in you[r] 6 pioneering papers[21]."

ENDNOTES

This ENDNOTE "ANNOTATION" was prepared for Oshins, E. (1987). Quantum Psychology Notes, vol. 1: A Personal Construct Notebook. Menlo Park, CA: Privately published.
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[1] Shepard, R.N., and Metzler, J. "Mental Rotation of Three-Dimensional Objects," Science, vol. 171, no. 3972, pp. 701-703, Feb. 19, 1971.

[2] Shepard, R.N., and Chipman, S. "Second-Order Isomorphism of Internal Representations: Shapes of States." Cognitive Psychology, 1: 1-17, 1970; Shepard, R.N. "Psychophysical Complementarity," in M. Kubovy and J.R. Pomerantz (eds.), Perceptual Organizations, Hillsdale, N.J.: Lawrence Erlbaum Associates, 1979; Shepard, R.N. "Ecological Constraints on Internal Representations: Resonant

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Kinematics of Perceiving, Imagining, Thinking, and Dreaming." Third James J. Gibson Memorial Lecture, Cornell University, October 21, 1983., in Psychological Review, vol. 91, no. 4, pp. 417-447, Oct. 1984.

[3] Bernstein, Herbert J., and Phillips, Anthony V. Phillips, "Fiber Bundles and Quantum Theory," Scientific American, July, 1981, p. 122.

[4] Kenneth Cohen, Personal Communications, 1980.

[5] Bernstein, N., The Coordination and Regulation of Movements, 1967; Pribram, K.H., Languages of the Brain: experimental paradoxes and principles in neuropsychology, 1971, § "an image-of-acheivement," pp. 243-6.

[6] In quantum theory, but not in classical theories, one shows [Foundations of Quantum Mechanics, J.M. Jauch, 1968, § 13-7, esp. problem # 4, pp. 241-244] that there exists a unitary square root of an inversion operation which transforms the position/momentum [Q_{op}/P_{op}] observable pair as a Fourier Transformation. In quantum representations, although not in classical representations, the momentum operator P_{op} is proportional to a spacial frequency operator K_{op}, according to the deBroglie relation. The constant of proportion is Plank's constant

Unitary transformations are the quantum analogy to rotations except that they conserve a sesquilinear form---ie. linear in one arguement and anti-linear in the other arguement---instead of a bilinear form. A consequence is that unitary, quantum Fourier transforms and inversion operators can be continuously "built up" from the identity in quantum representations, although this is not true for classical representations. An additional consequence of the quantum realization is that it provides an invariant to the unitary inversion operator, ie. parity, which

> "...has no classical analogue; there is no infinitesimal generator for a [classical] reflection." (Henley and Thirring, Elementary Quantum Field Theory, pp. 40-41).

The form of the unitary inversion transformation U_{Inv} and for the unitary Fourier transformation follow U_{FT}, where for consistancy with Jauch's notation, we adapt units in which Plank's constant is unity:

- Unitary Inversion Transformation $= \exp \{ i (\pi/2) (P_{op}^2 + Q_{op}^2)\}$

  $U_{Inv} = \exp \{ i (\pi/2) (K_{op}^2 + Q_{op}^2)\}$

- Unitary Fourier Transformation $= \exp \{ i (\pi/4) (P_{op}^2 + Q_{op}^2)\}$

  $U_{FT} = \exp \{ i (\pi/4) (K_{op}^2 + Q_{op}^2)\}$

The action of the unitary Fourier Transformation is to map

$$Q_{op} \text{--->} Q_{op}' = U_{FT}\ Q_{op}\ U_{FT}^{-1} = P_{op} \sim K_{op}, \text{ and}$$
$$P_{op} \text{--->} P_{op}' = U_{FT}\ P_{op}\ U_{FT}^{-1} = -\ Q_{op}, \text{ or}$$
$$K_{op} \text{--->} K_{op}' = U_{FT}\ K_{op}\ U_{FT}^{-1} = -\ Q_{op}$$

In his unpublished handout accompaniment to his November 16, 1982 Psychiatry Grand Rounds slide show at Stanford University Medical Center [Oshins (1982), "Quantum Logic and Schizophrenia (A Tool to Represent Schizophrenic Thought, Ambiguity and other Mental Processes);" also see SQUID test (e) "Natural Fourier Transforms," in Oshins (1984), Part II: "Experimental Proceedures for Searching For Spinor Representations of Global Symmetry in Mental Rotations using a Superconducting Quantum Interference Device," included in this notebook], Oshins has proposed that the brain "perform[s]" [sic. has] Fourier transforms by means of a such square root of an inversion, expressible through the relative phase relations between events. This is different than the classical interpretation of Fourier transforms which involves the actual physical motion of energy.

In 1984, Oshins noted that to have a "unitary inversion operator" within a quantum theory, forces one to employ the relativistic Dirac algebra, which can be realized as the direct sum of the Pauli algebra with its conjugate algebra, since an inversion in the Pauli algebra is antilinear.

[7] I refer here to the fact that holograms, like any other classical field theory, can be realized through a Poisson bracket formalism of the fields. In consequence the projection operators of the observable fields commute, ie. do not intertwine; and, thus, their spectral representatives can be added independently.

[8] Orlov, Y. (1982), "The Wave Logic of Consciousness: A Hypothesis." International Journal of Theoretical Physics, vol. 21, no. 1, p. 46. Also, see enclosed note excerpting Orlov's experimental description and eq. 25; and Oshins (1987), "Quantum Psycholgy looks at Kelly's Constructs," poster "Complementarity, Ambiguity, and Metalogics..." under "ambiguous representations".

[9] This somewhat obscure comment is meant to point out that, in quantum theory, momentum divided by spatial frequency yields a physically interpreted universal constant---Plank's constant of action. Imposing Heisenberg's equation's of motion allows the definition of a velocity operator. Imposing Galilean Relativity of inertial frames---in addition to Euclidean invariance---introduces Bargmann's constant in the factor structure of the ray representation [Bargmann, V. "On Unitary Ray Representations of Continuous Groups." Ann. Math., 59, 1-46, 1954; and Jauch, J.M., "Gauage Invariance as a Consequence of Galilei-Invariance for Elementary Partices," H.P.A., Vol. 37, 1964, pp. 284-292].

This leads to the physical interpretation of Plank's constant as: (1) an absolute mass scale instead of the relative mass scale of classical theories (Mackey, G.W., Induced Representations of Groups and Quantum Mechanics, 1968, §3.4, "consequences of Galilean Invariance," pp. 87-90), and as (2) the contraction parameter mapping the quantum commutators bracket "algebra of observables" into the classical Poisson bracket "algebra of observables"---the classical limit of the so-called "correspondence principle".

I add that gauge (phase) invariance in a such quantum (Galilean) formalism is equivalent to electricity & magnetism (Jauch, op. cit.). This is usually expressed by saying that electricity and magnetism is a U(1) local gauge theory.

[10] I quote from an unpublished Nov. 8, 1984 letter from E. Oshins to R. Shepard and E. Carlton in which, after presenting a short discussion of ray representations and probability, I give a simple explaination as to why holograms, which are composed of the electromagnetic field---or why any other energy carrying waves, such as Gabor's "logons"---do not have the required property of ray representations that when a ray is added to itself it remains the same:

> "...I point out that a Euclidean norm is what a physicist would speak of as a real, finite-dimensional Hilbert space. In physics, one considers rays in a complex Hilbert space. [See as examples Dirac, P.A.M. (1969), "The Basic Ideas of Quantum Mechanics", CTS-LN-69-1, Center For Theoretical Studies, University of Miami, Jan.-Mar., 1969, pp. 3-6; Dirac, P.A.M. (1976), The Principles of Quantum Mechanics, Revised Fourth Edition, Ch. 1 "The principle of superposition," pp. 1-22; Weyl, H., (1931), The Theory of Groups and Quantum Mechanics, pp. 4 & 20; and Houtappel, Van Dam, and Wigner (1965), "The Conceptual Basis and Use of the Geometric Invariance Principles," Reviews of Modern Physics, Vol. 37, No. 4, Oct. 1965, pp. 612-123, esp. pp. 610-613 in which the role of ray representations in quantum theory is discussed further.]
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> "These are normalized and defined only up to an arbitrary constant. This representation space is where the Hilbert space of quantum theory exists. The correspondent to orthogonal rotations in a Euclidean space is unitary (norm preserving) rotations of the ray in the Hilbert space, which are used to code symmetries and invariants. [See Houtappel, Van Dam, and Wigner, 1965, op. cit., esp $ 5.1, "Reason for the Increased Importance of Invariance Principles in Quantum Theory," p. 628; see also, Biedenharn, L.C., and Louck, J.D., (1981) Angular Momentum in Quantum Physics: Theory and Application, vol. 8 of Encyclopedia of Mathematics and its Applications, ed. Gian-Carlo Rota, 1981, pp. 3-4, and references cited there].
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> "These unitary transformations play a similar role to classical "canonical transformations". They preserve the structure of the physical theory. In the quantum case it is of the "commutator Lie product" or equivalently of the Heisenberg equations of motion. In classical theories it is of the Poisson Lie-product or equivalently of Hamilton's equations. This quantum substrate is the ball park from which I am trying to build a theory of induced internal representations...

"...By the way, ray representations may be relevant to...work about ratios being coded in the brain. In being defined only up to an arbitrary constant, the only quantities of physical interest are determined by the ratios of the components of the vectors. Another way to look at this is that a ray defines a direction in Hilbert Space. One obtains a "probability amplitudes" by taking a unit ray and projecting (as in projective geomentry) a component out along the direction of some unit basis vector. The resulting "direction cosines" are the "probability amplitudes" which in quantum theory are complex numbers. (This naming is unfortunate since quanta are pre-probability, as shown eg. by Piron, Foundations of Quantum Physics, esp. Ch. 4. I think "possiblity amplitude" is a much preferable term....It is like the confusion brought on by the name "uncertainty principle", which confuses "uncertainty" with "indeterminable". It is not a question of probability.)

"...According to a quantum approach, probability is constructed as expectation values of ensembles of quanta. This is something like the central limit theorem for eigenvalue equations. (Cf. eg. Finkelstein's "The Logic of Quantum Physics", Paper presented at meeting of The Section of Physical Sciences, March 20, 1963. Published in the Transactions of the New York Academy of Sciences, p. 63.)

"...This ray representation space of quantum information is the Hilbert space where Dirac's fundamental principle of linear superposition of quantum theory applies. In this regard, let me also make some comments about hologramic superpositions. If only because of quantum's ray representational structure, a "hologram model" for interference, is not a quantum theory. As clever as holograms may be, they are still Maxwell's equations realized in a classical phase space and is thus not a quantum theory. If you take a ray (an information state) in a quantum Hilbert space and double it, the intensity---which corresponds to a probability measure---of the ray stays the same. For a hologram, you get a 4 times increase."

[11] von Bekesey, G. (1967), Sensory Inhibition, pp. 220-226; Pribram, K.H. (1971), op.cit., pp. 167-171.

[12] As noted above, this would distinguish quantum ray representations from classical hologramish representations.

[13] Oshins (1984), Part II: "Experimental Proceedures for Searching For Spinor Representations of Global Symmetry in Mental Rotations using a Superconducting Quantum Interference Device," included in this notebook.

[14] Williamson, S.J., Kaufman, L., and Brenner, D. (1979) "Evoked neuromagnetic fields of the human brain," J. Appl. Phys. 50(3), March 1979, pp. 2418-2421.

[15] Brenner, D., Lipton, J., Kaufman, L., & Williamson, S.J., (1978), "Somatically Evoked Magnetic Fields of the Human Brain," Science, vol. 199, pp. 81-83.

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16 Finkelstein, D. (1974), "Space-Time Code. IV", Phys. Revs.D, vol. 9, no. 8, 15 April 1974, pp. 2219-2231, Sec. III "Relativistic Quantum Logic," pp. 2220-2224; and Finkelstein, D. (1977), "The Leibniz Project," Journal of Philosophical Logic, vol. 6, pp. 425-439, esp. Sec. II "Quantum Predicate Algebra," pp. 426-429.

17 Freud, S. (1925), "Negation," in General Psychological Theory: papers on metapsychology, ed. Philip Rieff, Collier Books, 1963, pp. 213-217; and Brandt, A. (1981), "What it means to say no," Psychology Today, Aug. 1981, pp. 70-77.

18 King, R., Raese, J., & Barcus, J., (1981), "Catastrophe Theory of Dopaminergic Transmission: A Revised Dopamine Hypothesis of Schizophrenia," prepublication draft submitted to J. Theoret. Biol..

19 See footnote 6 above.

20 Oshins, E. (1984), "A Quantum Approach to Psychology: Spinors, Rotations and Non-Selecting Ambiguity; and Oshins, E. (1987), op. cit.. poster "Physical Implications of Equivocation, Negation, and Serialization."

21 See listing in accompanying note "Quantum Psychology Bibliography," 12/86.