

**Subtle Connections:**  
**Grof, Jung, and the Quantum Vacuum**

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Are human beings entirely discrete individuals, their organism enclosed by the skin and their minds enclosed by the cranium housing the brain? Or are there effective, if subtle, interconnections between humans — and between humans and the world at large? This study argues that the latter assumption is likely to be true. Though the evidence for "subtle connections" is not in the form of incontrovertible "hard data" it is nevertheless cogent and significant. The directly pertinent findings are generated by research on psi-phenomena and the practice of psychotherapists. Possible explanations for the findings can be traced to the ideas of C.G.Jung, and are now pursued at the leading edge of the physical sciences.

**The Findings: (i) psi experiments**

Controlled experiments concerning subtle connections between subjects removed in space, and occasionally also in time, date back to the 1930s, to J.B. Rhine's pioneering card- and dice-guessing work at Duke University. Since then experimental designs have become sophisticated and experimental controls rigorous; physicists have often joined psychologists in carrying out the tests. Explanations in terms of hidden sensory cues, machine bias, cheating by subjects, and experimenter error or incompetence have all been considered, but they were found unable to account for a number of statistically significant results.

Relevant work began in the 1970s, when Russell Targ and Harold Puthoff carried out some of the best known experiments on subtle connections among distant subjects in regard to the transference of thoughts and images. They examined the possibility of telepathic transmission between individuals, one of whom would act as "sender" and the other as "receiver." The receiver was placed in a sealed, opaque and electrically shielded chamber, while the sender was in another room where he or she was subjected to bright flashes of light at regular intervals. Electroencephalograph (EEG) machines registered the brain-wave patterns of both. As expected, the sender exhibited the rhythmic brain waves that normally accompany exposure to bright flashes of light. But, after a brief interval the receiver also began to produce the same patterns, although he or she was not exposed to the flashes and was not receiving sense-perceivable signals from the sender.

Targ and Puthoff also conducted experiments on remote viewing. In these tests, sender and receiver were separated by distances that precluded any form of sensory communication between them. At a site chosen at random, the sender acted as a "beacon"; the receiver then tried to pick up what the beacon saw. To document his or her impressions, the receiver gave verbal descriptions, at times accompanied by sketches. Independent judges found that the descriptions of the sketches matched on the average 66 percent of the time the characteristics of the site that was actually seen by the beacon.

Remote viewing experiments reported from other laboratories involved distances from half a mile to several thousand miles. Regardless of where they were carried out, and by whom, the success rate was generally around fifty percent — considerably above random probability. The most

successful viewers appeared to be those who were relaxed, attentive, and meditative. They reported that they received a preliminary impression as a gentle and fleeting form, which gradually evolved into an integrated image. They experienced the image as a surprise, both because it was clear and because it was clearly elsewhere.

Images could also be transmitted while the receiver was asleep. Over several decades, Stanley Krippner and his associates carried out "dream ESP experiments" at the Dream Laboratory of Maimondes Hospital in New York City. The experiments followed a simple yet effective protocol. The volunteer, who would spend the night at the laboratory, would meet the sender and the experimenters on arrival and had the procedure explained to him or her. Electrodes were then attached to the volunteer's head to monitor brain waves and eye movements; there was no further sensory contact with the sender until the next morning. One of the experimenters threw dice that, in combination with a random number table, gave a number that corresponded to a sealed envelope containing an art print. The envelope was opened when the sender reached his or her private room in a distant part of the hospital. The sender then spent the night concentrating on the print.

The experimenters woke the volunteers by intercom when the monitor showed the end of a period of rapid eye-movement (REM) sleep. The subject was then asked to describe any dream he or she might have had before awakening. The comments were recorded, together with the contents of an interview the next morning when the subject was asked to associate with the remembered dreams. The interview was conducted double blind — neither the subject nor the experimenters knew which art print had been selected the night before.

Using data taken from the first night that each volunteer spent at the dream laboratory, the series of experiments between 1964 and 1969 produced 62 nights of data for analysis. They exhibited a significant correlation between the art print selected for a given night and the recipient's dreams on that night. The score was considerably higher on nights when there were few or no electrical storms in the area and sunspot activity was at a low ebb — that is, when the Earth's geomagnetic field was relatively undisturbed.

A particularly striking example of transpersonal contact and communication has been the work of Jacobo Grinberg-Zylverbaum at the National University of Mexico. In more than fifty experiments performed over five years, Grinberg-Zylverbaum paired his subjects inside sound- and electromagnetic radiation-proof "Faraday cages." He asked them to meditate together for twenty minutes. Then he placed the subjects in separate Faraday cages where one of them was stimulated and the other not. The stimulated subject received stimuli at random intervals in such a way that neither he or she nor the experimenter knew when they were applied. The non-stimulated subject remained relaxed, with eyes closed, instructed to feel the presence of the partner without knowing anything about his or her stimulation.

In general, a series of one hundred stimuli were applied — flashes of light, sounds, or short, intense but not painful electric shocks to the index and ring fingers of the right hand. The EEG of both subjects was then synchronized and examined for "normal" potentials evoked in the stimulated subject and "transferred" potentials in the non-stimulated subject. Transferred potentials were not found in control situations where there was no stimulated subject, where a screen prevented the stimulated subject from perceiving the stimuli (such as light flashes), or when the paired subjects did not previously

interact. However, in experimental situations with stimulated subjects and with interaction, the transferred potentials appeared consistently in some 25 percent of the cases. A particularly poignant example was furnished by a young couple, deeply in love. Their EEG patterns remained closely synchronized throughout the experiment, in consonance with their report of deep feelings of oneness.

In a limited way, Grinberg-Zylberbaum could also replicate his results. When a subject exhibited the transferred potentials in one experiment, he or she usually exhibited them in subsequent experiments as well.

A related experiment investigated the degree of harmonization of the left and right hemispheres of the subject's neocortex. In ordinary waking consciousness the two hemispheres — the language-oriented, linearly thinking rational "left brain" and the gestalt-perceiving intuitive "right brain" — exhibit uncoordinated, randomly diverging wave patterns in the electroencephalograph. When the subject enters a meditative state of consciousness, these patterns become synchronized, and in deep meditation the two hemispheres fall into a nearly identical pattern. In deep meditation not only the left and right brains of one and the same subject, also the left and right brains of different subjects manifest identical patterns. Experiments with up to twelve subjects simultaneously showed an astonishing synchronization of the brain waves of the entire group.

In the past few years, experiments such as these have been matched by hundreds of others. They provide significant evidence that identifiable and consistent electrical signals occur in the brain of one person when a second person - especially if he or she is closely related or emotionally

linked - is either meditating, provided with sensory stimulation, or attempts to communicate with the subject intentionally.

Interpersonal connection beyond the sensory range can also occur outside the laboratory; it is particularly frequent among identical twins. In many cases, one twin feels the pain suffered by the other and is aware of traumas and crises, even if he or she is halfway around the world. Besides "twin pain," the sensitivity of mothers and lovers is equally noteworthy: countless stories are recounted of mothers having known when their son or daughter was in grave danger, or was actually involved in an accident.

Interpersonal connection is not limited to twins, mothers, and lovers; the kind of closeness that a therapeutic relationship creates between therapist and patient seems also to suffice. A number of psychotherapists have noted that, during a session, they experience memories, feelings, attitudes, and associations that are outside the normal scope of their experience and personality. At the time these strange manifestations are experienced they are indistinguishable from the memories, feelings and related sentiments of the therapists themselves; it is only later, on reflection, that they come to realize that the anomalous items stem not from their own life and experience, but from their patient.

It appears that in the course of the therapeutic relationship some aspect of the patient's psyche is projected into the mind of the therapist. In that location, at least for a limited time, it integrates with the therapist's own psyche and produces an awareness of some of the patient's memories, feeling, and associations. Known as "projective identification," the transference can be useful in the context of therapy: it can permit the patient to view what was

previously a painful element in his or her personal consciousness more objectively, as if it belonged to somebody else.

Actual physical manifestations seem also capable of being transmitted from one individual to another. Transmissions of this kind came to be known as "telesomatic": they consist of physiological changes that are triggered in the targeted person by the mental processes of another. The distance between the individuals involved seems to make little or no difference. William Braud and Marilyn Schlitz carried out hundreds of trials regarding the impact of the mental imagery of senders on the physiology of receivers — the latter were distant, and unaware that such imagery was being directed to them. They claim that the mental images of the sender can "reach out" over space and cause changes in the physiology of the distant receiver — effects comparable to those one's own mental processes produce in one's own body. People who attempt to influence their own bodily functions are only slightly more effective than those who attempt to influence the physiology of others from a distance. In several cases involving a large number of individuals, the difference between remote influence and self-influence was almost insignificant: "telesomatic" influence by a distant person proved to be nearly as effective as "psychosomatic" influence by the same person.

**The Findings: (ii) Grof's experience with altered states of consciousness**

Complementing psi-experiments in regard to the ability of the human mind to penetrate beyond the limits of personal sensory experience are the

findings of modern psychotherapists. The pertinent evidence comes clearly to the fore in the work of Stanislav Grof. In reviewing findings gathered in the course of over three decades, Grof suggests that the standard cartography of the human mind needs to be complemented with additional elements. To the standard "biographical-recollective" domain of the psyche we should add a "perinatal" and a "transpersonal" domain. The transpersonal domain, it appears, can mediate connection between our mind and practically any part or aspect of the phenomenal world.

Grof's experience derives from work with non-ordinary states of consciousness (NOSCs), induced in his patients either by psychedelic drugs or holotropic breathing. NOSCs embrace a large part of the human psyche; the states of normal waking consciousness are but the tip of the iceberg. As over a hundred years ago William James had noted, "Our normal waking consciousness...is but one special type of consciousness, whilst all about it, parted from it by the filmiest of screens, there lie potential forms of consciousness entirely different. We may go through life without suspecting their existence; but apply the requisite stimulus, and at a touch they are all there in all their completeness." People in "primitive" and classical cultures knew how to apply the requisite stimulus — some tribes, such as the !Kung Bushmen of the Kalahari desert, could enter altered states all at the same time.

In many parts of the world, ancient peoples combined chanting, breathing, drumming, rhythmic dancing, fasting, social and sensory isolation, even specific forms of physical pain to induce altered states. The native cultures of Africa and pre-Colombian America used them in shamanic procedures, healing ceremonies and rites of passage; the high-cultures of

Asia used them in various systems of yoga, Vipassana or Zen Buddhism, Tibetan Vajrayana, Taoism, and Sufism. The Semitic cultures used them in Cabala, the ancient Egyptians in the temple initiations of Isis and Osiris; the classical Greeks in Bacchanalia and the rites of Attis and Adonis as well as in the Eleusinian mysteries. Until the advent of Western industrial civilization, almost all cultures held such states in high esteem for the remarkable experiences they convey and the powers of personal healing and interpersonal contact and communication they render accessible.

Today, at the leading edge of the contemporary sciences, research on non-ordinary states of consciousness is becoming accepted as a legitimate part of the new discipline known as "consciousness research." The insight that surfaces is, as Charles Tart noted, that these states tend to make our connections to each other and to our environment more evident. Grof's records of the verbal reports of his patients makes this very clear.

In the "experience of dual unity" a patient in a NOSC experiences a loosening and melting of the boundaries of the body ego and a sense of merging with another person in a state of unity and oneness. In this experience, despite the feeling of being fused with another, the patient retains an awareness of his or her own identity. Then, in the experience of "identification with other persons," the patient, while merging experientially with another person, has a sense of complete identification to the point of losing the awareness of his or her own identity. Identification is total and complex, involving body image, physical sensations, emotional reactions and attitudes, thought processes, memories, facial expression, typical gestures and mannerisms, postures, movement, and even the inflection of the voice. The "other" (or others) can be someone in the presence of the patient

or someone absent; he or she can be part of an experience from the subject's childhood, his or her ancestry, or even of a previous lifetime.

In "group identification and group consciousness" there is a further extension of consciousness and melting of ego boundaries. Rather than identifying with individual persons, the patient has a sense of becoming an entire group of people who share some racial, cultural, national, ideological, political, or professional characteristics. The depth, scope, and intensity of this experience can reach extraordinary proportions: people may experience the totality of suffering of all the soldiers who have ever died on the battlefield since the beginning of history, the desire of revolutionaries of all ages to overthrow a tyrant, or the love, tenderness and dedication of all mothers in regard to their babies. Identification can focus on a social or political group, the people of an entire country or continent, all members of a race, or all believers of a religion.

"Identification with animals" goes beyond the human transpersonal dimension: it involves a complete and realistic identification with members of various animal species. The experience can be authentic and convincing, including body image, specific physiological sensations, instinctual drives, unique perceptions of the environment, and the corresponding emotional reactions. The nature and scope of these experiences distinguish them from ordinary human experiences; they often transcend the scope of fantasy and imagination.

While less frequent, "identification with plants and botanical processes" occurs as well. On occasion, patients have a complex experience of becoming a tree, a wild or garden flower, a carnivorous plant, kelp, *Volvox globator*,

plankton in the ocean, a bacterial culture, or an individual bacterium. In the still more embracing experience of "oneness with life and all creation" an individual expands his or her consciousness to such an extent that it encompasses the totality of life on this planet, including all of humanity and all the flora and fauna of the biosphere. Instead of identification with one living organism, the patient identifies with life itself as a cosmic phenomenon.

Experience in NOSCs can also penetrate beyond the sphere of life: it can include the macroscopic and microscopic phenomena of the inorganic world. In the "experience of inanimate matter and inorganic processes" patients report experiential identification with the waters of rivers and oceans, with various forms of fire, with the earth and with mountains, and with the forces unleashed in natural catastrophes such as electric storms, earthquakes, tornadoes, and volcanic eruptions. They can identify with specific materials, such as diamonds and other precious stones, quartz crystals, amber, granite, iron, steel, quicksilver, silver, and gold. The experiences extend into the microworld and may involve the dynamic structure of molecules and atoms, Brownian motions, interatomic bonds, electromagnetic forces, and subatomic particles. Grof concludes that every process in the universe that in an ordinary state of consciousness can be objectively observed, can also be subjectively experienced in a non-ordinary state.

The cosmic dimensions of the experiences in NOSC can encompass all of the planet Earth. In "planetary consciousness" the subject's consciousness expands to the Earth's geological substance with its mineral kingdom and its biosphere with all its life forms. The Earth as a whole

appears to be one complex organism, oriented toward its own evolution, integration, and self-actualization. In "extraterrestrial experiences" — a further expanded form of consciousness — other celestial bodies and astronomical processes are included. The subject can experience traveling to the moon, sun, other planets, stars, and galaxies; he or she can experience explosions of supernovas, contraction of stars, quasars and pulsars, even passage through black holes. The experience can occur in the form of simply witnessing such events, or of actually becoming them, experiencing them intimately, as if being a part of the experienced thing or event. At the widest (and comparatively rare) form of this experience — "identification with the entire physical universe" — the subject has the feeling that his or her consciousness encompasses the entire cosmos. All its processes are experienced as part of the organism and psyche of the all-encompassing universe-system.

In addition to the spatially expanded forms of consciousness, there are experiences that recall OBEs (out-of-body experiences), clairvoyance, clairaudience, and telepathy. More relevant for our purposes are experiences involving a displacement in time. Time-displacement experiences range from "embryonal and fetal experiences," where the subject recalls his or her intrauterine life as a fetus, through "ancestral experiences" involving identification with one's biological ancestors, "racial and collective experiences" where those involved are not one's direct ancestors but members of the same race, or sometimes the entire human species (suggestive of Jung's "collective unconscious" of which more will be said later), all the way to "past incarnation experiences." The essential characteristic of the latter is a convincing sense of remembering something that had already happened in

the history of the same person. Subjects maintain their sense of individuality and personal identity, but experience themselves in another form, at another place and time, and in another context. In these reincarnation-type experiences the birth of the individual appears as a point of transformation, where the enduring record of multiple lifetimes enters the bio-psychological life of the individual.

According to Grof, the memories that surface in past incarnation experiences share with other transpersonal experiences the capacity to provide instant and direct extrasensory access to information about some aspect of the world. If so, all divisions and boundaries in the universe are illusory and arbitrary; in the last analysis, it is only a cosmic consciousness that actually exists.

### **Toward an Explanation: (a) Jung's *unus mundus***

What explanation can we give for the varied yet remarkably consistent phenomena unearthed in controlled psi-experiments and in the work of Grof and other psychotherapists with patients in altered states of consciousness? Just what is the nature of the "cosmic consciousness" — or similar factor — that would connect our psyche with the world at large?

Carl Jung, fascinated with this seemingly esoteric aspect of the human psyche, attempted an explanation in terms of a higher or deeper reality that would connect human minds with each other as well as with physical reality. He was led to his explanatory concept by a comparison of unconscious processes in individuals with the myths, legends, and folktales of a variety of cultures at various periods of history. Jung found that the individual records

and the collective material contain common themes. This prompted him to postulate the existence of a collective aspect of the psyche: the "collective unconscious." The dynamic principles that organize this material are the "archetypes." Archetypes are irrepresentable in themselves, but have effects that make visualizations possible: these are the archetypal images and ideas. "The archetype as such is a psychoid factor that belongs, as it were, to the invisible, ultraviolet end of the psychic spectrum. It does not appear, in itself, to be capable of reaching consciousness."

While in the realm of the spirit, at the upper, "ultraviolet" end of the psychic spectrum, archetypes are dynamic organizers of ideas and images, at the lower, "infrared" end of the spectrum the biological instinctual psyche shades into the physiology of the organism, merging with its chemical and physical conditions. As Jung noted, "...the position of the archetype would be located beyond the psychic sphere, analogous to the position of physiological instinct, which is immediately rooted in the stuff of the organism and, with its psychoid nature, forms the bridge to matter in general.

Jung formulated his concept of the archetype in collaboration with Wolfgang Pauli. He was struck by the fact that while his own research into the human psyche led to an encounter with such "irrepresentables" as the archetypes, research in quantum physics had likewise led to "irrepresentables": the micro-particles of the physical universe, entities for which no complete description appeared possible.

Jung concluded: "When the existence of two or more irrepresentables is assumed, there is always the possibility — which we tend to overlook —

that it may not be a question of two or more factors but of one only." The single factor that underlies the irrepresentables of physics and of psychology may be the same as that which underlies the synchronicities Jung had investigated: meaningful coincidences that tie together in an acausal connectedness the physical and the psychological worlds. Jung named the common factor that would underlie and connect these worlds "*unus mundus*." The foundation for the *unus mundus* is "...that the multiplicity of the empirical world rests on an underlying unity, and that not two or more fundamentally different worlds exist side-by-side or are mingled with one another."

As Charles Card summarized, "The realms of mind and of matter—*psyche* and *physis*— are complementary aspects of the same transcendental reality, the *unus mundus*. Archetypes act as the fundamental dynamical patterns whose various representations characterize all processes, whether mental or physical. In the realm of the *psyche*, archetypes organize images and ideas. In the realm of *physis*, they organize the structure and transformations of matter and energy, and they account for acausal ordering as well. Archetypes acting simultaneously in both the realms of *psyche* and *physis* account for instances of synchronistic phenomena."

Jung's relates the subtle connections that appear in synchronistic events involving the psyche of different individuals, as well as the psyche of one person and the physical world around that person, to an underlying reality that emerges in the form of archetypes. The fundamental reality — *unus mundus* — is itself neither psychic nor physical: it stands above, or lies beyond, both *psyche* and *physis*.

## **Toward an Explanation: (b) The Quantum Vacuum**

Jung's concept points the way toward a fruitful avenue of research: a deeper reality that connects mind and mind, and mind and matter. This approach should enter the current stream of consciousness research. For the present, most researchers seek an explanation of mental events mainly in terms of physical processes in the brain. But henceforth the mental events to explain should include not only the workings of the individual brain but, in light of the findings of psi-experimenters and psychotherapists, the subtle connections that link human brains with each other and with the world at large.

It seems likely that world and brain — cosmos and consciousness — are interconnected by a continuous information-conserving and transmitting *field*. Such a field cannot be postulated in an *ad hoc* manner — science must respect the law laid down by William of Occam in the 14th century: entities are not to be multiplied beyond necessity. New entities — which can also be forces or fields — can only be postulated when doing so is the *simplest*, the most *economical* and the most *rational* way of explaining a given set of findings and observations.

A field that constitutes the simplest, the most economical and rational explanation of the current findings may exist: David Bohm, the same as this writer, suggested that it is the as yet imperfectly understood "zero-point field" (ZPF) that seems present throughout the quantum vacuum. In the following, we shall explore what is known about this field of the vacuum, what is currently hypothesized about it, and how it could account for the subtle interconnections noted above.

*Received knowledge about the vacuum* -- In quantum physics the quantum vacuum is defined as the lowest energy state of a system of which the equations obey wave mechanics and special relativity. It is considerably more than just the state of a system, however. It is the locus of a vast energy field that is neither classically electromagnetic nor gravitational, nor yet nuclear in nature. Instead, it is the originating source of the known electromagnetic, gravitational, and nuclear forces and fields. It is the originating source of matter itself.

The technical definitions of the quantum vacuum point to a continuous energy sea in which particles of matter are specific substructures. According to Paul Dirac's calculation, all particles in positive energy states have negative-energy counterparts (by now such "antiparticles" have been found experimentally for all presently known particles). The zero-point field of the quantum vacuum is a "Dirac-sea": a sea of particles in the negative energy state. These particles are not observable — physicists call them "virtual." But they are not fictional for all that. By stimulating the negative energy states of the ZPF with sufficient energy (of the order of  $10^{-27}$  erg), a particular region of it can be "kicked" into the real (that is, observable) state of positive energy. This is the process known as pair-creation: out of the vacuum emerges a positive energy (real) particle, with a negative energy (virtual) particle remaining in it. Thus the Dirac-sea is everywhere; the observable universe floats, as it were, on its surface.

The quantum vacuum contains a staggering density of energy. John Wheeler estimated its matter-equivalent at  $10^{94}$  gram per  $\text{cm}^3$  — and that is more than all the matter in the universe put together. Compared with this

energy density, the energy of the nucleus of the atom — the most energetic chunk of matter in the known universe — seems almost minuscule: it is "merely"  $10^{14}$  gram/cm<sup>3</sup>.

The vacuum itself is not material: its zero-point energies — which, according to David Bohm, exceed all the energies bound in matter  $10^{40}$  times — are in the negative state. This is fortunate, for if they were not, the universe would instantly collapse to a size smaller than the radius of an atom. (This follows from  $E = mc^2$ , Einstein's celebrated mass-energy equivalence relation: energy corresponds to mass, and mass in turn entails gravitation.)

Because the "real" world of matter — that is, of energy bound in mass — is so much less energetic than the vacuum, the observable universe is not a solid condensate floating on top of the vacuum, but like a set of bubbles suspended in it. In terms of energy, the material world is not a *solidification* of the quantum vacuum, but a *thinning* of it.

*Speculations on the vacuum* -- A thin line divides what is already known and accepted about the quantum vacuum and what is still speculative and controversial. Here we review the relevant explorations: those that concern interactions between the observable world of matter-energy and the vacuum's zero-point energies.

The world of matter and the quantum vacuum are known to interact. For example, under certain conditions vacuum's zero-point energies act on electrons orbiting atomic nuclei. The effects occur when electrons "jump" from one energy state to another: the photons they emit exhibit the so-called Lamb-shift (a frequency slightly shifted from its normal value). Vacuum

energies also create a radiation pressure on two closely spaced metal plates. Between the plates some wavelengths of the vacuum field are excluded, thereby reducing its energy density with respect to the field outside. This creates a pressure — known as the Casimir effect — that pushes the plates inward and together.

Other interactions may exist as well. Some years ago, Hungarian physicist Lajos Jánosy assigned "relativistic effects" (such as the slowing down of clocks when accelerated close to the speed of light, or the increasing of the mass of objects at those velocities) to the interaction of real-world objects (?) with the vacuum's energy field. Close to the speed of light the matter-particles of objects rub against the force-particles (bosons) of the vacuum, and this friction slows down their processes and increases their mass. In this concept the ZPF of the vacuum is a physical field that interacts with the objects that move in space and time.

Currently another Hungarian, maverick theoretician László Gazdag, developed Jánosy's concept into a full-fledged "post-relativity theory." In his theory the vacuum's energy field has the properties of a superfluid. It is known that in supercooled helium all resistance and friction ceases; it moves through narrow cracks and capillaries without loss of momentum. Conversely, objects move through the fluid without encountering resistance. (Since also electrons move through it without resistance, superfluids are also superconductors.) Thus, in a sense, a superconducting superfluid is not "there" for the objects or electrons that move through it — they get no information about its presence. This could explain why we, and even our most sensitive instruments, fail to register its presence.

In Gazdag's reinterpretation of Einstein's relativity theory the celebrated formulas describe the flow of bosons in the superfluid ZPF. This flow is what determines the geometrical structure of spacetime, and hence the trajectory of real-world (?) photons and electrons. When particles of light and matter move uniformly, spacetime is Euclidean; when they are accelerated the ZPF interacts with their motion. Then spacetime appears curved. (As Russian physicist Piotr Kapitza noted, in a superfluid only those objects move without friction that are in constant quasi-uniform motion. If an object is strongly accelerated, vortices are created in the medium and these vortices produce resistance: the classical interaction effects surface.)

Front-line research in physics confirms the basic notion that underlies these assumptions. Current work follows up a suggestion made by physicists Paul Davies and William Unruh in the mid-1970s. Davies and Unruh, like Jánossy and Gazdag, based their argument on the difference between constant-speed and accelerated motion in the vacuum's zero-point field. Constant-speed motion would exhibit the vacuum's spectrum as isotropic (the same in all directions), whereas accelerated motion would produce a thermal radiation that breaks open the directional symmetry. The "Davies-Unruh effect," too small to be measured with physical instruments, prompted scientists to investigate whether accelerated motion through the vacuum field would produce incremental effects. This expectation has borne fruit. It turned out that the inertial force itself could be due to interactions in that field.

In 1994 Bernhard Haisch, Alfonso Rueda and Harold Puthoff gave a mathematical demonstration that inertia can be considered a vacuum-based Lorentz-force. The force originates at the subparticle level and produces

opposition to the acceleration of material objects. The accelerated motion of objects through the vacuum produces a magnetic field, and the particles that constitute the objects are deflected by this field. The larger the object the more particles it contains, hence the stronger the deflection — and greater the inertia. Inertia is thus a form of electromagnetic resistance arising in accelerated frames from the distortion of the zero-point (and otherwise superfluid) field of the vacuum.

More than inertia, also mass appears to be a product of vacuum interaction. If Haisch and collaborators are right, the concept of mass is neither fundamental nor even necessary in physics. When the massless electric charges of the vacuum (the bosons that make up the superfluid zero-point field) interact with the electromagnetic field, beyond the already noted threshold of energy, mass is effectively "created." Thus mass may be a structure condensed from vacuum energy, rather than a fundamental given in the universe.

If mass is a product of vacuum energy, so is gravitation. Gravity, as we know, is always associated with mass, obeying the inverse square law (it drops off proportionately to the square of the distance between the gravitating masses). Hence if mass is produced in interaction with the ZPF, then also the force that is associated with mass must be so produced. This, however, means that *all* the fundamental characteristics we normally associate with matter are vacuum field-interaction products: inertia, mass, as well as gravity.

In regard to the full scale of interactions between vacuum energies and the micro- as well as macro-world of matter-energy, the work of a group of

Russian physicists is of particular significance. Anatoly Akimov, G.I. Shipov, V.N. Binghi and co-workers developed a sophisticated theory of what they call the "physical vacuum." In their theory the vacuum is a real physical field extending throughout the universe: it registers and transmits the traces of both micro-particles and macro-objects. The theory, which at the time of writing has not been published outside Russia, is important and fascinating enough to merit some further details.

In standard theories the energetic properties of the quantum vacuum are generally considered in the framework of quantum electrodynamics. This framework gives rise to elegant and relatively simple mathematics. But such formulas, though highly sophisticated, can be misleading: they may not provide the best possible account of physical reality. Stochastic electrodynamics, for example, produces a more "messy" math, but its tenets about the real world may be closer to realistic assumptions about the nature of reality. In any case, quantum electrodynamics, as other scientific theories, can always be reconsidered or extended.

The Russian physicists do not hesitate to undertake this step. They take their cue from earlier work by Einstein. In a seminal treatment, G.I. Shipov showed that in accordance with the Clifford-Einstein program of the geometrization of spacetime, the vacuum can be described not only in terms of Riemannian (four-dimensional) curvature, but also in terms of Cartan torsion. In the 1920s, studies carried out by Albert Einstein and E. Cartan laid the foundation of the theory that became subsequently known as the ECT (Einstein-Cartan Theory). The idea stemmed originally from Cartan, who at the beginning of the century speculated about fields

generated by angular momentum density. This idea was later elaborated independently by a number of Russian physicists, including N. Myshkin and V. Belyaev. They claim to have discovered the natural manifestations of enduring torsion fields.

Presently Akimov and his team consider the quantum vacuum as a universal torsion wave-carrying medium. The torsion field is said to fill all of space isotropically, including its matter component. It has a quantal structure that is unobservable in non-disturbed states. However, violations of vacuum symmetry and invariance create different and, in principle, observable states.

The torsion field theory takes a modified form of the original electron-positron model of the "Dirac-sea": the vacuum's energy field is viewed as a system of rotating wave packets of electrons and positrons (rather than a sea of electron-positron pairs). Where the wave-packets are mutually embedded, the field is electrically neutral. If the spins of the embedded packets have the opposite sign, the system is compensated not only in charge, but also in classical spin and magnetic moment. Such a system is said to be a "phyton." Dense ensembles of phytions are said to approximate a simplified model of the physical vacuum field.

When the phytions are spin-compensated, their orientation within the ensemble is arbitrary. But when a charge  $q$  is the source of disturbance, the action produces a charge polarization of the vacuum, as prescribed by quantum electrodynamics. When a mass  $m$  is the source of disturbance, the phytions produce symmetrical oscillations along the axis given by the direction of the disturbance. The vacuum then enters a state characterized by

the oscillation of the phytons along their longitudinal spin-polarization; this is interpreted as a gravitational field (G-field). The gravitational field is thus the result of vacuum decompensation arising at its point of polarization — which is an idea that was originally introduced by Sakharov. Given that the gravitational field is characterized by longitudinal waves, it cannot be screened, which is in accordance with observation and experiment. Hence  $m$ -disturbance produces the G-field, much as  $q$ -disturbance produces the electromagnetic field.

Akimov *et al.* go further. Following a thesis advanced by Roger Penrose, they represent the vacuum equations in the spinor form and thereby obtain a system of nonlinear spinor equations where two-component spinors represent the potentials of torsion fields. These equations can describe charged, as well as neutral, quantum and classical particles. They thus allow that the vacuum field is disturbed not only by charge and mass, but also by classical spin. In that event the phytons oriented in the same direction as the spin of the disturbance keep their orientation. Those opposite to the spin of the source undergo inversion; then the local region of the vacuum transits into a state of transverse spin polarization. This gives the "spin field" (S-field), viewed as a condensate of fermion pairs.

As a result Akimov *et al.* view the vacuum as a physical medium that can assume various polarization states. Given charge polarization, the vacuum is manifested as the electromagnetic field. Given matter-polarization, it is manifested as the gravitational field. And given spin-polarization, the vacuum manifests as a spin-field. All fundamental fields known to physics correspond to specific vacuum polarization-states.

Thus the above "torsion-field theory of the physical vacuum" can claim that all objects, from quanta to galaxies, create vortices in the vacuum. The vortices created by particles and other material objects are information carriers, linking physical events quasi-instantaneously. The group-speed of these "torsion-waves" is of the order of  $10^9 C$  — one billion times the speed of light. Since not just physical objects, but also the neurons in our brain create and receive torsion-waves, not only particles are "informed" of each other's presence (as in the famous EPR experiments), but also humans can be so informed: our brain, too, is a vacuum-based "torsion-field transceiver." This suggests a physical explanation not only of quantum non-locality, but also of telepathy, remote viewing, and the other telesomatic effects discussed above.

Torsion waves are both superluminal and enduring. Meta-stable "torsion-phantoms" generated by spin-torsion interaction can persist even in the absence of the objects that generated them. The existence of these phantoms has been confirmed in the experiments of Vladimir Poponin and his team at the Institute of Biochemical Physics of the Russian Academy of Sciences. Poponin, who has since repeated the experiment at the Heartmath Institute in the US, placed a sample of a DNA molecule into a temperature controlled chamber and subjected it to a laser beam. He found that the electromagnetic field around the chamber exhibits a specific structure, more or less as expected. But he also found that this structure persists long after the DNA itself has been removed from the laser-irradiated chamber: the DNA's imprint in the field continues to be present when the DNA is no longer there. Poponin and his collaborators conclude that the experiment shows that a new field structure has been triggered from the physical

vacuum. This field is extremely sensitive; it can be excited by a range of energies close to zero. The phantom effect is a manifestation, they claim, of a hitherto overlooked vacuum substructure.

Theories such as those we have cited here foreshadow a major leap in the scientific world picture: the physical foundations of the universe acquire an active role in all its functions and processes. Life, and even mind, is a manifestation of the constant if subtle interaction of the wave-packets classically known as "matter" with the underlying physically real zero-point vacuum field.

If the emerging world picture is to be completed, we must evolve an explicit hypothesis to describe the basic dynamics of the overall range of matter-vacuum interaction. In this writer's "quantum-vacuum interaction (QVI) hypothesis," the non-classical energy field of the vacuum (consisting of scalar as well as electromagnetic wave propagations) registers the spacetime behavior and evolution of matter-energy systems in the form of interfering wavefronts. The conserved interference patterns form a holographic information field accessible to systems with a stereodynamic pattern isomorphic to the systems that produced the patterns.

The applicable process can be described as forward and reverse Fourier (more exactly, Gabor) transforms. Hence matter-energy systems ranging from quanta to complex atomic, molecular, cellular and multicellular structures, including human brains, decode ("read out") the information they and analogous systems have encoded ("read into") the field. Given that wavefronts superpose in multiple dimensions, the ZPF of the vacuum acts as an information-conserving and transmitting universal holofield, intercon-

necting systems with each other, as well as with their subsidiary systems (internal parts) and suprasystems (external environments).

## **Conclusions**

The astonishing psi-phenomena that come to light in controlled experiments, and the equally astonishing findings of expert psychotherapists cannot be dismissed as mere chimera, figments of a fertile but undisciplined imagination. The findings are part and parcel of the manifestation of human consciousness: an entity whose subconscious domains extend far beyond the confines of the subject's brain and organism.

The findings may be real, yet their acceptance hinges critically on discovering ways to connect them with the received frameworks of knowledge. As long as there is no conceivable tie between an anomaly and the basic paradigm that frames knowledge in the pertinent field, the anomaly will remain just that: a paradoxical, uncomprehended item, relegated to the back shelf of the science establishment. Recognition of a conceivable tie could, however, make for a significant difference — it could open up feasible avenues of conceptual analysis, theory-formulation, and experimental testing. For that reason likely hypotheses of brain-brain and brain-universe (or, in an alternative terminology, consciousness-consciousness, and consciousness-world) interaction need to be seriously scrutinized, for intrinsic meaningfulness, consistency with observations, as well as mesh with the currently known frameworks of explanation.

In the case discussed above, the scientific validation of the findings would have an additional bonus. Not only would it introduce greater

coherence into our world picture — binding together the hitherto anomalous findings of consciousness research with our knowledge of the physical world — it would also introduce greater coherence into human affairs. As thoughtful observers have frequently remarked, many of our current ills are due to the sense of separateness and lack of empathy we experience vis-à-vis our fellow humans and the nonhuman realms of nature (in modern societies, as Woody Allen quipped, "nature and I are two"). The scientist's recognition that we do have deeper ties to each other and to the natural environment could make a significant impact on the media, and therewith on the dominant attitudes of the public.

T.S. Eliot asked, "What are the roots that clutch, what branches grow out of this stony rubbish? Son of man you cannot say, or guess, for you know only a heap of broken images..." Perhaps, the exploration of our subtle ties with each other and with nature could enable us to know more than a heap of broken images. It could help us to recognize Bateson's "pattern that connects": the subtle connecting pattern present in the cosmos and in the biosphere — and likewise in our brain and consciousness.