

The Psychophysical Matrix and Group Analysis

Andrew Powell

This paper extends the author's earlier ideas on the matrix. Correlations are drawn between major strands of experimental physics and experiences common to the group. In non-technical language the paper touches on the essential features of Newtonian physics, Albert Einstein's theories of relativity, quantum mechanical theory and the concept of the arrow of time. Evolutionary implications of time are discussed with reference to entropy and chaos theory. The deterministic picture of reality, which informs the Newtonian world-view, can be found in certain group phenomena reminiscent of Isaac Newton's Laws of Motion and Gravitation. In contrast, the 'relativity' matrix highlights the generative function of mind that creates three-dimensional reality. The quantum effects of wave and particle find expression respectively in the experience of solitariness and states of fusion. The cosmological whole, which these various interpretations of reality each reflect in part, is represented by the integration of these themes within the mandala of the group.

I have elsewhere summarized S.H. Foulkes's concept of the matrix (Foulkes, 1964, 1973; Foulkes and Anthony, 1965) and how this widened to include the idea of the group as a living organism, a psychological equivalence of the neurophysiological discoveries of Kurt Goldstein (Powell, 1989, 1990, 1991a, 1992). I suggested that Foulkes came to an impasse because he could not find a coherent foundation on which to rest both his earlier reductive-analytic work and his later, instinctive leaning towards 'the whole', representing the synthetical viewpoint espoused by Carl Jung and, in more recent years, the transpersonal movement in psychology. I described how Jung's theory of archetypes (Jung, 1946), though never intended for the benefit of group analysis, gives rise through the integration of the oppositional forces experienced within the mandala of the group to the notion of the individuation of the group. The goal is the emergence of a 'higher' group self, a striving for transformation in which each group member participates. It is a transcendental process, which ultimately might be called religious, in the sense of the Latin religare, meaning to tie again, not us to ourselves but to our common source, that greater whole from which we spring by means of biological conception and to which we return when we die.

Moving from depth psychology to the 'new' physics, I drew a parallel with the image of network and node as used by Foulkes (1964: 118); this is a metaphor with interdependent parts, just like the image of wave and particle in quantum mechanics. In contemplating the very large and the very small (described by the theories of relativity and quantum theory respectively), I attempted to delineate the matrix in so far as it can be revealed through the physical sciences (Powell, 1991b). In this paper, my aim is to enlarge on this vision of the matrix. I make no apology for drawing on psychological, psychophysical and spiritual truths alike. In any event, I believe that the very nature of group analysis places us at the epicentre of overlapping bodies of knowledge, so that we should feel encouraged to try our hand at many ideas. If

our efforts seem amateur, no matter, for human progress depends not so much on intellectual prowess as on curiosity and imagination.

The Basic Premise

We usually think of ourselves as separate human beings as we go about our daily business. We seem to be acting independently and often like to think that this is so. As existential philosophers have emphasized, there is a sense in which we are each truly alone. But in certain respects, we are strangely blind to the way our lives run together in a collective flow.

We see this phenomenon most strikingly when we observe the activity of a colony of ants. Only when the colony is viewed as a whole does the true scale of operations become evident. Watson (1986) points to the research during the 1920s of the South African naturalist Eugene Marais, whose studies on termites revealed the amazing complexity of the architecture of their mounds. Marais postulated that all societies, from ants to people, were shaped according to a 'group psyche or soul'. This remark is in line with Aristotle's view that the part is in essence subservient to the whole - for example, the leaf to the tree - and that increasing complexity of function is no accident, but should be understood as purposeful in the expression of the life form.

The evolutionary antecedent of this process can be found in the slime mould *Dictyostelium discoideum* (Prigogine and Stengers, 1984), consisting of some hundred thousand cells which function quite independently as long suitable bacteria are available for digestion. When food runs out, the cells aggregate in pulsatile waves to form a creature with 'head' and 'tail' which can move like a slug towards light and water. The body can even form a stalk so that the 'head' is elevated as a spore-bearing organ that can release spores for aerial dispersion.

Closer to home, it rarely occurs to us to question how it is that the thousand billion cells that make up the healthy human body manage to live for the most part in extraordinary harmony. We are inclined to see and experience only the whole, except when something goes wrong with a body part. Because at the macroscopic level of perception we sense the body as solid, we may forget that at a sufficient level of magnification, there is no such thing as solidity, only an energy field. It need come as no surprise to find that the electromagnetic energy field, which is coterminous with the physical human body, turns out to be visible to some people as the aura (Hunt et al., 1977). Research has not yet established the extent to which this force field is a product of cellular activity or to what extent, in the reverse sense, it is the guiding principle to which cells respond chemically, hormonally and physiologically. Systems theory and cybernetics suggest it is likely to be both.

I am drawing attention to the intimate state of connectedness, which forms the invisible matrix of our space-time dimensional reality, for we now know that three-dimensional space arises as an artefact of consciousness. There is really no such 'thing' as space. Equally naive are the assumptions we make about the nature of time, that curious man-made dimension regulated by the tick of a clock.

The Framework of Classical Physics

To examine these statements more closely, we turn first to Newton's great work *Principia Mathematica*, published in 1687. Newton advanced the idea that time is absolute and can be used as a standard by which all other events in the universe can be measured. But the nature of this time is like the

swing of a pendulum; it can flow either forwards or backwards (1). This is a fundamental attribute of Newton's Laws of Motion which asserted that: 1) every body continues in its state of rest or of uniform motion in a straight line unless it is compelled by a force to change that state; 2) change of motion is proportional to the applied force and takes place in the direction of the force, and 3) to every action there is always an equal and opposite reaction. Finally, Newton's law of gravitation stated that objects exhibit a gravitational force towards each other in inverse-square proportion to the distance between them. Thus, it was proposed, were the planets of our solar system held in orbit around the sun.

Science now had an orderly and entirely mechanistic model of the cosmos, which led the mathematician Pierre Laplace (1749-1827) to pronounce that an intelligent being who at any moment knew all the forces in nature, and also the position of all the things of which the universe consists, should be in a position to reproduce the movements of the greatest bodies and those of the smallest atoms in a single formula. Then nothing would be uncertain for him, and both future and past would be known. This was the scientific climate that informed Sigmund Freud's life work and is to be found expressed most succinctly in *Project for a Scientific Psychology* (Freud, 1895).

Theories of Relativity

In 1917, with the publication of his General Theory of Relativity, Einstein broke the mould of 250 years. He proposed a space-time fabric in which stars and planets, having mass, would bend the very substance of space-time, like putting a rock in the centre of a sheet of stretched rubber. Space-time would now curve and no longer would a straight line be the shortest distance between two points (2). Thus, Newton's famous apple falls to earth not on account of a mysterious force called 'gravity', but because of 'merely rolling into the local space-time "well" created by the earth' (Coveney and Highfield, 1991: 90). The relationship is a mutual one in which 'space tells matter how to move ... matter tells space how to curve' (Halpern, 1990: 17).

Einstein also showed that light loses energy when trying to escape from a gravitational field, so that its waveform is slowed down. To an observer it would seem that events themselves would take longer to happen (the time dilation effect) (3). Just as Newton put an end to the notion of absolute position in space, so Einstein put an end to absolute time. Some ten years earlier, Einstein had formulated the Special Theory of Relativity in which energy and mass were shown to be interchangeable. The theory was founded on two postulates; first, all motion is relative and second, the speed of light is always recorded as being the same (4). This enabled him now to consider what it would be like to be a ray of light passing from the sun to the earth. At the speed of light, length in the direction of travel shrinks to zero, as does time also. Therefore, from the point of view of the light ray, it goes no distance in zero time. The concept of speed is meaningless for the passage of light itself is instantaneous.

What does this suggest about the whole of our three-dimensional physical world? It is no more and no less than the very act of our observing this light ray travelling from the sun to earth, which has drawn it out into the dimensions we know as space and time (Russell, 1992). For each second of what we call time, the ray has travelled what we call a distance of 186,000 miles, in the case of sun to earth, taking 8 minutes to travel 93 million miles. The breathtaking implication is that space and time are not things in themselves but are created by the act of consciousness. Our bodies can only exist in time

and space (or they would not be bodies), but without our minds, there would be no bodies, no planet and no universe.

The mathematics of string theory, a recent brainchild of the new physics, go even further, suggesting that there are up to 25 dimensions to space and that at the earliest stages of the universe, when 'stringiness' was dominant, all these dimensions existed on an equal footing (Barrow, 1991). As the universe expanded and cooled, only four dimensions (space and time) survived as we know them, and the rest curled up into a tiny space, billionths of an inch across.

While these tiny dimensions may be negligible for solid bodies, what of the mind which, unlike the brain, has no mass? To consider this implication, we must turn to quantum theory, which examines the smallest imaginable events taking place in the universe, in which properties of mass are negligible.

Quantum Mechanics

Pivotal to quantum theory is the Wheeler delayed-choice experiment. A radioactive source is used to beam single light particles (photons) through a screen with two separate slits. Behind each slit is a particle detector. Only one of the two detectors at any one time will register the impact of the photon, which, it can be concluded, is behaving as a particle travelling through either one or other slit. But if a single detector screen is placed in front of the two particle detectors, an interference pattern will form, indicating that the light is travelling simultaneously through both slits and spreading out as waves interacting to form interference bands. Light has been shown to behave either as particle or wave, depending on the intervention of the experimenter.

This uncertainty is characteristic of quantum theory, which is a theory of micro-events based on probabilities. An electron does not 'hop' from one orbit to another around the nucleus, like a spinning billiard ball. It first extends into all orbits in a waveform, trying them all out for size, as it were. Then, at the moment of measurement, the wave function vanishes and the electron 'appears' as a particle, having a definite position in space and with a measurable spin.

The way that the act of observation determines the outcome is called 'the collapse of the wave'. But once we move from subatomic to large-scale events, bizarre possibilities follow. For instance, in one famous thought experiment, the physicist Erwin Schrodinger considered the fact of a cat inside a box. In the box is a small radioactive source causing the emission of electrons. Electrons have a spin which, when measured, will move either upwards or downwards. In this experiment, upward spinning particles only will trigger a particle detector to release a lethal dose of cyanide.

The puzzle is this: until the electron has been observed, it can only exist as a mixed wave function. In turn, the particle detector can only respond with a wave function of mixed up and down signals. Thus, it follows that in theory the unseen cat also can only exist as a hybrid, its wave function being a mixture of dead cat quantum state and live cat quantum state. But on opening the box, the observer will cause the wave to collapse, precipitating the electron into a particle with spin. At that moment, entirely on account of its being observed, the cat either lives or dies!

Quantum theory challenges the whole notion of causality. Einstein worried greatly about this, remarking 'God does not play dice'. In 1935, Einstein, Boris Podolsky and Nathan Rosen set up a thought experiment which argued that two spinning particles which first interacted and then were separated in space would in theory still be related, even if light years apart, by virtue of the

common wave form which they shared. Einstein thought this impossible but as it turned out, he was wrong. In 1972, John Clauser, using a complex arrangement of photons, calcite crystals and photo-multipliers, demonstrated experimentally that reversing the spin of the one particle instantaneously reversed the spin of the other (Dossey, 1982). In 1982, Alain Aspect showed that this synchronicity, which transcends the speed of light, even holds between distant regions of space-time (Coveney and Highfield, 1991).

This discovery links the micro-universe of quantum effects with the macro-universe of relativity. Nor does the operation of the uncertainty principle, which puts limits on the accuracy of momentum and position of a particle, stand in the way of the apparent stability of large-scale events. It is just that for a billiard ball to move one millionth of an inch on its own, one would have to be prepared to wait upwards of a billion years.

Implications for the Matrix

Let us summarize the argument so far. The new physics has closed a gap between science and the mind, which has lain wide open since Rene Descartes. Everything is truly connected to everything else, and mind is the creative force in the making of it. Objects without mass 'communicate' at any distance, by means of a dimensionality as yet unknown but which transcends the physical limitations even of the speed of light. Closer to hand, while light itself knows no such thing as space and time, from the first moment of consciousness, we continuously 'invent' reality of a physical kind so that it flows as smoothly and effortlessly as a stereoscopic video.

These many and continuing discoveries have prompted the physicist David Bohm to coin the term 'the Hologverse', in which 'the entire universe has to be thought of as an unbroken whole' (Bohm, 1980: 175). In it, space and time are manifestations of what Bohm calls the 'explicate' order, no more than one special case within a generality of implicate orders, which enfold us and in which space and time are not in themselves dominant. Indeed, while the human mind, as we know it, requires to be enfolded in physical reality, at one and the same time it appears to enfold and contain the totality.

The Psychophysiology of Mind

We have moved on some way from nodes and networks. As the images of quantum theory enter more into everyday life, the evocative power of particle and wave comes into play, representing the limited versus the boundless, the personal versus the universal and the individual versus the collective. While reality is always destined to be meta-reality, since it has to be mediated through our special sense organs, the quantum metaphor may turn out to be more than a case of serendipity. Zohar (1990) points this out, arguing that the quality of unbroken wholeness, which is fundamental to consciousness, is known to be characteristic of inorganic materials which exist in 'condensed phases', such as magnets, superconductors and lasers, where all the molecules have the property of functioning together as a whole. Recently there is evidence that the same process takes place in biological tissues and at normal body temperatures as molecules vibrate in unison, forming electrically charged dipoles. The alignment of the electromagnetic field causes individual cell identity to give way to function as a whole. A single waveform, called a Bose-Einstein condensate (Marshall, 1989), has taken over, and Zohar (1990: 69) suggests it is the neurophysical substrate for consciousness, a 'ground state of awareness,

the blackboard on which things (perceptions, experience, thoughts, feelings, etc.) are written’.

This mechanism appears to be transpersonal. In the mid-1970s, Russell Targ and Harold Puthoff at the Stanford Research Institute demonstrated that pairs of people who had an emotional affinity could respond at a distance to each other's brainwaves. When one of the pair was exposed to a flashing light, the alpha rhythm of the other showed inhibition (Watson, 1986). Now from the USA comes research showing that identical twins, separated from birth, are found later in their lives not only to be temperamentally alike, but to wear the same clothes, have similar hobbies and even to have chosen the same jobs (Bouchard et al., 1990). It seems that once joined, whether electrons in a photoelectric tube or twins in the womb, the state of connectedness persists despite separation in time and space. This lends a new meaning to the old saying, ‘There is no such thing as divorce!’ Equally, the implication holds that once a group has formed, its matrix exists in space and time independently of its intermittent physical coming together.

A Very Brief History of Time

Since day-to-day reality is structured by the three dimensions of space plus time, the concept of the arrow of time has a bearing on the matrix no less than quantum-generated non-local correlations. Concerning the history of time, overwhelming evidence has steadily accumulated to suggest that it all began with the ‘Big Bang’ some 15 billion years ago (6).

At the outset the universe had zero size and was infinitely hot. After one second, the temperature fell to about ten billion degrees. Its actual substance was now composed of three kinds of sub-atomic particles, photons, electrons, and neutrinos, along with their respective anti-matter. The electrons and anti-electrons set about annihilating each other, producing a lot more light and, fortunately for us, leaving a slight excess of matter over anti-matter, or the universe would have completely combusted (7).

Within three minutes, the remaining neutrons and protons had cooled to about one billion degrees, enough to form stable atomic nuclei of hydrogen and helium. Then everything stopped for about one million years while the universe went on cooling and expanding. Because of a slight unevenness in the total gravitational field, clumping of vast clouds of hydrogen and helium gas began. Once started, the energy released by these collapsing regions of space generated immense nuclear fusion reactions, giving birth to the stars. The biggest stars burn for the shortest time, as little as one hundred million years, generating billions of tons of oxygen and carbon, until all the hydrogen is spent (8). Such stars finally erupt in massive supernovas when, in a few seconds, they release more energy than in their entire lives, flinging out all the elements millions of miles into space. Some elements are incorporated into the next generation of stars and others condense to form planets. The atoms that make up the cells of our bodies are every one made of stardust. We are as old as the universe (9).

This summary of cosmological time is based on the assumption that time, like a river, flows onwards. But just as we may begin to question the dimensionality of space, so do similar questions arise about the true nature of time.

Entropy and the Flow of Time

Newton's concept of absolute time had been overthrown by Einstein. But Einstein believed, like Newton, that the universe was a static, eternal entity and that time, therefore, had no one direction in which to flow (10). Can quantum mechanics help? Surely an arrow of time is provided by the collapse of the wave function? Unfortunately, this does not generate a linear time-flow on two counts. First, in the twin-particle experiment, far-flung areas of space are instantly connected and the principle of causality is violated. Second, it has been shown that 'the quantum kettle never boils'. (An unstable nucleus, which through radioactive decay should give off measurable electrons, is actually stopped in its tracks from doing so by continuous measurement!) We have to turn back 150 years to a different body of evidence to find an experimental benchmark for our daily perception of linear time.

The physical basis for the arrow of time derives from the first and second laws of thermodynamics conceived by Rudolf Clausius in the mid-nineteenth century (Halpern, 1990). Following a study of steam-driven machines, Clausius stated in his first law that energy could never be gained or lost but is constant, being merely converted from one form to another. He went on to define a measure called entropy, which increases as the energy that is available in a system to do work (as for instance across a temperature gradient) is used up. The second law states in brief that the entropy of the universe strives to a maximum (11).

From these laws has emerged the study of equilibrium thermodynamics. At its simplest, a chemical reaction will continue until 'the equilibrium, or fixed-point attractor' has been reached, like a ball-bearing which will run down a slope till it reaches the bottom and comes to rest.

Fortunately for all life forms, within this universal principle of increasing entropy there have been shown to be numerous 'non-equilibrium attractors', which defy the second law of thermo-dynamics (12). Prigogine has demonstrated how at far-from-equilibrium conditions, complex new molecular structures suddenly appear, unforeseen and unpredictable, which he calls dissipative structures (Prigogine and Stengers, 1984). There is now shown to be a vast range of such structures in chemical and biological systems, throwing up a whole variety of patterns, whirls, stripes and colour changes, some of which regularly oscillate and so form naturally occurring 'clocks' (13). To quote Prigogine and Stengers:

Biological systems have a past. Their constituent molecules are the result of an evolution; they have been selected to take part in the autocatalytic mechanisms to generate very specific forms of self-organization (1984: 153).

More recently, a new phenomenon has been uncovered called the 'strange' or 'chaotic attractor'. It is enormously sensitive to initial conditions, so that time-symmetrical determinism, as described by Newton and Laplace, is destroyed in favour of 'chaotic evolution' (14). A good example is provided by meteorology, where predictions have to be recast hourly. Edward Lorenz coined the phrase 'butterfly effect' in which the beating of a butterfly's wings on one side of the world could, in theory, cause a hurricane on the other. This is the implication of chaos theory; it comes about not by a collision of random events but by the behaviour of physical, chemical and biological clocks at far-from-equilibrium conditions (15).

We now have a model in which the evolutionary arrow of time is 'nested' within the greater entropic framework of cosmological time. But, by the same

token, chaos theory and non-linear thermodynamics have shown that the future cannot with any certainty be predicted by the past.

Finally, what of psychological time? It seems likely that the phenomenon of subjective time arises when we treat what we observe as being separate from ourselves. The two-component system, subject and object, brings about 'collapse of the wave' and produces a measurable outcome in the everyday world as we know it. This will hold true whether the object is someone or something else or the observer looking at himself, that is, behaving as both subject and object. An event so created has become linked with an irreversible moment in time. But in entirely subjective states of mind concerned solely with 'being' in which there is no object, such as in states of meditation and transcendental reality, the subject remains within the wave, there is no collapse of the wave and instead a characteristic sense of oneness and timelessness is experienced.

Cosmology might suggest mankind has only a very small part to play in the cosmic order of things. But the physicist John Wheeler has proposed a thought experiment, derived from quantum theory, which puts mankind back on the map. Imagine an observer some light years away from a quantum mechanical experiment. The experiment is carried out but the observer does not decide until later whether he wants to measure the momentum or the position of the particle released. When this decision is made, at some point in the future, it must therefore determine the outcome of the experiment in the past. Could it be that the cosmos has a self-observing relationship, the emergence of consciousness determining those very initial conditions which millions of years later will allow it to evolve (Tilby, 1992)? If so, and in accordance with the Gnostic viewpoint, God needs man as much as man needs God.

Further Implications for the Matrix

Foulkes pointed out (Foulkes and Anthony, 1965) that the relationships of the wider world or macrosphere are all to be found in the microsphere of the group. This touches on the image of container/contained, a concept developed by Bion (1970). Like the 'Russian doll' phenomenon, it extends from the smallest of organisms composed of cytoplasm and bounded by a single cell membrane through to the organization of the cosmos. The human psyche, in its first flush of consciousness, has resisted taking its place in the larger order of things. This is why the Gaia hypothesis (Lovelock, 1979) has met with such opposition: we still like to think, grandiosely, that we are the stewards of the earth. On the other hand, once we acknowledge that the structure of mind (if we are not to go mad), calls for an enduring sense of containment, it is there to be discovered in the embrace of the universe. Whether we discern in the cosmological mirror the mother/infant pair or instead become entranced by the beauty of fractals (16) depends on what we look to find. But we can be assured that the revelations of science, far from detracting, should enhance what must always be the miracle of the birth of the human individual, body and soul.

Art and psychoanalysis have both paid homage to this miracle. As Daisetz Tzuzuki has written, '[Man's] ... hands and feet are the bushes and the whole Universe is the canvas on which he depicts his life' (Herrigel, 1953). Now surely it is time for psychotherapists to welcome science and find reflected in the great cosmological mystery our own search for meaning.

A Psychophysical Schema

The schema relates certain kinds of experience found within the group to the several interpretations of reality outlined in this paper. The argument for making such correlations lies in recognizing that the matrix is multifaceted, that it can never be known directly but only through its manifestations in overlapping truths. The concept of the Holoverse suggests that an infinite number of correlations could be found, since everything is ultimately connected to everything else. But as we happen to be situated in three-dimensional space and time, the correlations we elicit need to be meaningful in those terms, either aesthetically or in a practical sense. The analytic group is the ideal place to find them, looking as it does, both inwards and outwards and, *pars pro toto*, providing a window onto landscapes without horizon.

The Matrix of Newton's Laws

The group experience of reality is shaped by the fact of individual embodiment in the human form. Like the orbiting planets in space, body and psyche are both contained within the skin boundary; the group member is well placed to be the observer of his or her own experience. Outside of this, varying degrees of proximity and distance are maintained, governed by forces of attraction towards, or repulsion from, the other group members.

Also in line with Newton's Laws, change is avoided through inertia or resistance until compelled to take place from without. Equal and opposite reactions tend to be generated; love begets love and hate begets hate. Such emotions are characteristic of the skin-encapsulated ego.

In the group, physical indicators lie in such things as lateness, pushing one's chair back from the circle or choosing where to sit. Absence from the group represents the attempt to escape from its influence. The circular arrangement ensures equidistance in which centrifugal and centripetal forces make the centre of the group its core, emphasized by the use of the low, round table.

The group offers stability in space and time. There is a clear framework for analysis of cause and effect and for making sense of experience. Time is reversible, for group members travel back and forth in time as they report on and relive scenes from their life experience. Within this framework, whole-object transferences take place and can be clarified. Yet the inner world of the individual is preserved and identity can be maintained through self-regulation. If there is a danger, it is that there may be a sense of helplessness to change anything.

The Newtonian group matrix corresponds to some extent to Foulkes's levels one and two of group process, of social reality and family-based transferences (Foulkes, 1964). This is possibly because the same kind of mental activity gave rise both to Newton's theories and the psychoanalytic vision of reality.

The Matrix of Relativity

Experience of reality is characterized by a dynamic interplay between subject and object, which gives to each an intimate influence on the form and substance of the other. The group is highly interpersonal and reactive to both inner and outer worlds. There are no 'forces' in operation but, to use Einstein's term, a space-time fabric in which all things, mental and physical, intimately relate. (The physical structure of the group embodies a curved space-time geodesic.)

The mind, having no mass, works at the speed of light. Indeed, it continuously creates time and space in its moment-by-moment construction of the three-dimensional world (though being outside those dimensions, it is not to be found situated anywhere within them, least of all in the brain). In the group, this generative process is reflected in the awareness of ultimately being responsible for one's actions and for one's state of mind. Problems may arise if a group member has an unstable identity, for the enfoldment of dimensions can lead to confusion in space and time. This may be manifested in projective identification and part-object transferences.

The group has the capacity for inherent creativity and generativity. Changes can take place suddenly and surprisingly, just as dissipative structures occur in nature. But this needs to be balanced with periods of equilibrium, in which linear time can reassert itself and the consequences of chaos can be usefully assimilated. Again, a degree of comparison can be made with Foulkes's levels of group process, this time with the third, or projective level, and with its underlying 'body' level (Foulkes, 1968).

The Matrix of the Quantum Particle

The group embodies absolute individual aloneness. The particle, as a representation of consciousness, has been born of the wave, and there is no return. The self is located in space, but with no known past, and an uncertain future, truly an existential condition. Yet in this aloneness is the knowledge of the universality of the condition. Just as it has been shown that two particles, once joined, can never be separated, so each individual belongs in the remote past to the waveform, which gave rise to all the cosmos. Reality is not just what each individual creates of time and space for him or herself but is, with the collapse of the cosmological wave, what we have all been born out of, and into.

There is no consensus about the nature of the observing presence that caused that first wave to collapse. Some people see in it the hand of God. We may speculate that the group conductor, in selecting patients for a stranger group, does something similar when he or she first puts the case notes together. Once crystallized in space and time, the group maintains its own indissoluble reality by virtue of the quantum matrix that it forms.

Every particle requires a witness for it to exist. The psyche arranges for this when we are physically alone or sleeping by the activities of the internal object world. In the group setting, members experience an ever-deepening realization of self through other. By a happy coincidence, the mirror reaction has both a quantum and group-analytic connotation.

The Matrix of the Quantum Wave

The whole group can be thought of as a Bose-Einstein condensate. For periods of time, which may of course be only brief, individual group members stop functioning as separate beings, lose track of their self-consciousness and flow together in a merged or fused state. The awareness often comes through silence; its quality may be predominantly emotional, or it may be aesthetic in the sense of sensing and seeking out a 'higher' plane of consciousness experienced as transcendental. Images, if they occur, are often of wholeness and completion.

Healing groups and consciousness-raising groups deliberately harness the quantum wave phenomenon, but equally it has an important part to play in the analytic group, provided we are not afraid to follow it. Our difficulty is that such experience is not enshrined within the framework of analytic therapy

except in terms of regression to the breast, or by reference to oceanic bliss or primary narcissism. This suggests that an infantile reaction is going on and that the transference should be 'worked through', so that a healthy individuality can later emerge. This is not the interpretation that the quantum group deserves, although like every other kind of group, it can under certain conditions assume a defensive function. Rather, immersion in the quantum wave is to relinquish ego striving and to stand at the gateway of what Jung (1916) called the 'transcendent function'.

It remains to add that the two forms of quantum matrix coexist, just as do wave and particle. Often there will be an oscillation of the group between the two. The themes of separateness and closeness are twinned (both are also well represented in depth psychology). But each quantum state taps into the primordial past, having a cosmological significance. Together they amount to a synthesis or wholeness that is irreducible: in this sense, they represent Foulkes's fourth and 'deepest' level of group process, except that the metaphor of depth now fails to capture the image.

The Matrix, Time and Space

The concept of the matrix, which Foulkes first articulated, reflects the creative process which inspired both Einstein and Jung; its evolutionary significance is revealed in the study of non-equilibrium thermodynamics, dissipative structures and strange attractors, all taking place within the cosmic entropic process.

Newtonian causal determinism helps us to make sense of how we come to be where we now are in our lives. Looking back, it is possible to trace the path taken through time and space and to understand how the choices were made. But at far-from-equilibrium conditions, which characterise personal crises and major life events, causal determinism breaks down. There is no going back and the future is unknown, just as with the collapse of the wave in quantum theory. Relativity theory suggests that the future is in our own hands, for we create it with every thought and deed. Whether we experience it more as particle or wave is up to us. There is much to be said for doing both.

The varieties of psychological time described in this paper are set, 'figure on ground', against our awareness of the cosmological arrow of time which impales each of us, carrying us bodily forward from birth to death. Whether we see this as the beginning and end, or we interpret the transcendental experience of time to mean there is more to it than one mere life, is a personal matter. But we can hardly ignore the findings of cosmology, for they furnish us with another vision of the whole. *Et nova et vetera!* To return to Jung's alchemical metaphor, it is now one in which classical physics, relativity theory, quantum particle and quantum wave, comprise a *quarternio oppositorum*, contained as always by the mandala of the group.

Cosmology has yet to come up with a Grand Unified Theory, the philosopher's stone of our age. In our group work we sense the workings of the universe in the ebb and flow of the group as it pivots from one aspect of reality to another. This is the inevitable behaviour of mind, which being the child of consciousness is as anxious to secure 'the truth' as the infant is to possess the breast. If, on the other hand, we dare to concern ourselves with the soul, we are at once in touch with all that is indivisible and inexhaustible, for we are now contained within the whole and have it in us to become the whole. According to the Gnostic tradition, we each carry a divine spark; in the group the spark becomes a flame, just as the cosmos burst into heat and light. And while we

might regard light as a thing apart, consciousness is what we bring to life. The gift needs to be handled with care, for as the wise old Rabbi exclaimed, 'What is hell? It is to have God sit you on his knee and show you what your life could have been!'

Notes

1. The factor of reversibility of time can be grasped by thinking of a billiard ball bouncing off the cushion of the table. On film, this event could be run forwards or backwards with no way of telling which was which.

2. The nearest thing to a straight line in curved space is called a geodesic. For example, we only travel in a circle around the sun so long as we think in our familiar three dimensions. In four-dimensional space-time, we are simply moving along a geodesic in the company of the sun (Hawking, 1988).

3. This is illustrated by a black hole in space: the aftermath of the death of a large star that has collapsed inwards on itself under the weight of its own massive gravitational field. All light (and therefore everything else) is sucked inwards towards a point of infinite density and space-time curvature, called a singularity. An observer watching a spaceman falling into such a hole would see him appearing to move slower and slower till he was motionless. Time would not subjectively alter for the spaceman but unfortunately he would soon become crushed by the weight of millions of tons of neutrons streaming together.

4. These postulates predict that if you were to travel past me in space at 87 per cent of the speed of light, your clock would run at half the speed of mine, as would your whole world. Further, the length of your spaceship would only appear to be half its normal length. And finally, because there is an equivalence of mass and energy, expressed by Einstein's formula, $E = mc^2$, if you went on to attain the speed of light, your mass would become infinite. This is hypothetical since moving an object of infinite mass needs an infinite amount of energy, more than the universe contains, and therefore no material object can travel as fast as the speed of light (Russell, 1992).

5. The electron remains elusive to the extent that if its position is known, then its momentum is unattainable: in accord with Heisenberg's uncertainty principle, both cannot be measured at the same time.

6. We cannot know what the 'Big Bang' arose from, since the density of the universe and the curvature of space-time were both infinite (what is called a singularity, in which the whole notion of space-time collapses) (Hawking, 1988). But we know that in the beginning, there was indeed light, as the Bible tells us, issuing from an indescribable fireball.

7. This excess was no more than one part in a billion, a rather crucial ratio, for more would have generated a dense gravitational field rapidly swallowing all matter up into a gigantic black hole, and less would have meant a massive expansion to the extent that the universe would have blown itself apart.

8. An accelerating chain of combustion takes place, the star in turn burning helium, carbon, neon and then, for just a few days, the residual silicon which finally fuses into iron (Russell, 1982). As the fire dies out, the star's energy fails and it collapses in on itself. Below a critical size, it leaves behind it the ghostly shadow of a neutron star a few miles across. Bigger stars either implode to form black holes or explode as supernovas.

9. Our solar system is thought to be 5 billion years old, as against the 15 billion years of its parent universe, and our sun, which is relatively small and therefore slow burning, is about half way through its life span. The sun is one of a hundred billion stars in just one of the hundred billion galaxies within range of the radio telescope, in all some 15 billion light years across.

10. The theory of relativity says only that within our universe, cause must always come before effect. Dropping the tea cup on the floor must precede its breaking into pieces. Time dilation effects may influence the speed of events but not the sequence. We could equally well live in a universe having a reverse time flow, in which we would each

know our future and nothing of our past, and where an anti-gravitational field would lift up broken cups and cause them to become whole!

11. A system with low entropy has much available energy to be used, for example when a coal fire heats a cool room. But when the coal has burned up, and the room has correspondingly warmed, while the total energy is unchanged, it is no longer available to be put to work and the system is said to have high entropy. In the case of the universe, this end point will be heat death, some hundred billion years hence.

12. The first evidence for a non-linear attractor came in what is known as the Rayleigh-Bernard cell. On heating a thin layer of silicone oil between two plates of glass, it was found that a honeycomb pattern of hexagonal cells of convecting liquid would appear, which could be maintained as long as the heat was applied. According to traditional thermodynamics, the heat should simply have caused the molecules to rush about more quickly. Instead, at far-from-equilibrium conditions, millions of molecules lock into a totally new structure, as if entering a single synchronized time with which they all move in step, an extraordinary feat of cooperation.

13. These far-from-equilibrium systems are governed by 'limit-cycle attractors', which rather than the fixed-point attractor of the ball-bearing coming to rest at the bottom of a slope, would be more like the ball-bearing running round and round the brim of a hat (Coveney and Highfield, 1991).

14. There are regions of the universe in which conditions may be quite different from ours (Barrow, 1991). The theory of symmetry-breaking physics predicts that we are part of the evolution of a 'chaotic inflationary universe' in which neighbouring regions are expanding and developing at different speeds.

15. At a certain threshold or crisis point, the clock initiates a new pathway, like the fork in a road. Push still further from equilibrium and the path forks again in half the time. Repeated bifurcation follows until a chaotic overload results. Such is thought to be the basis of ventricular fibrillation in heart muscle. This extreme end-point is, of course, pathological. But chaotic attractors are also thought to work in harmony to provide, in health, the basic rhythmic activity of the cardiac pacemaker cells.

16. Strange attractors generate fractal objects (the term coined by Benoit Mandelbrot), which are geometric patterns showing the same design regardless of the scale of magnification. Somewhat like the Russian doll effect, but without any discontinuity, an example would be the detailed examination of a snowflake crystal. Using a microscope to focus on the edge of the flake, it will be seen that the configuration of the whole crystal repeatedly comes into view, as the level of magnification is steadily intensified.

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