Near-Death Studies and Modern Physics

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ABSTRACT: The fields of near-death studies and modern physics face common dilemmas: namely, how to account for the corroborative nature of many near-death experiences or of the anthropic disposition of the universe without allowing for some otherworldly existence and/or some guiding intelligence. Extreme efforts in both fields to explain various phenomena by contemporary scientific methods and theories have been largely unsuccessful. This paper exposes some of the principal problem areas and suggests a greater collaboration between the two fields. Specific illustrations are given where collaborative effort might be fruitful. The paper also suggests a broader perspective in performing the research, one that places greater emphasis on an otherworldly thrust in future research.

Efforts to explain the near-death experience (NDE) have tended to focus on theories to explain the NDE as a biological, mental, psychological or social phenomena and theories that explain it as a real occurrence. These attempts have been proposed by researchers and theorists from a number of different fields. They tend to fall into a number of categories of explanation that include cultural, pharmacological, physiological, neurological, psychological, and religious.

These many attempts at explanation include such factors as prior social or cultural conditioning (Rodin, 1980), drugs and sensory deprivation (Grof and Halifax, 1977; Palmer, 1978; Siegel, 1980), cerebral anoxia or hypoxia, temporal lobe seizures, and altered states of

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consciousness (Blacher, 1979; McHarg, 1978; Schnaper, 1980), temporal lobe dysfunction, hypoxia/ischemia, stress, and neuropeptide/neurotransmitter imbalance (Saavedra-Aguilar and Gómez-Jeria, 1989a) sigma receptors and excitatory amino acid receptors (Saavedra-Aguilar and Gómez-Jeria, 1989b), NMDA-PCP receptor, the sigma receptor, and the endopsychosins (Jansen, 1989, 1990), serotonergic mechanisms (Morse, Venecia, and Milstein, 1989), brain-stem function (Cook, 1989), endorphin release (Blackmore, 1993; Thomas, 1976), stress-induced limbic lobe dysfunction (Carr, 1982), autoscopic hallucinations (Lukianowicz, 1958), the replay of the birth experience (Sagan, 1979), the depersonalization syndrome occurring in the face of life-threatening danger (Noyes and Kletti, 1976), altered state triggered by the threat of imminent physical death (Quimby, 1989), protective functions to conserve energy and provide necessary brain stimuli (Krishnan, 1981), hallucinations (Gibbs, 1987; Menz, 1984; Siegel, 1980); the denial of death (Ehrenwald, 1978), regression in the face of death (Lowental, 1981), stress induced psychological phenomena (Appleby, 1989), fulfillment of prior personal expectations of death (Schnaper, 1980), multiple personality disorder (Serdahely, 1992), psychological transition (Tien, 1988), hypnagogic sleep (Counts, 1983), and religious expectations (Palmer, 1978).

To an increasing extent recent NDE literature has described cases where the most likely explanation is that the human personality exists as both a physical body and a spiritual, or otherworldly, body. In many of these cases the out-of-body nature of the experience is demonstrated where the individual saw things that could not have been seen from the physical body, either because of position or because of the physical state of the body, and the things that the individual claimed to have seen are later verified by the individual or others. We choose to call these types of experiences *corroborative NDEs*. In a letter to the editor of this Journal, the Board of Directors of the Utah chapter of the International Association for Near-Death Studies described four such corroborative NDEs, and concluded:

> These four experiences are by no means exhaustive of what can be found in the literature. They should be sufficient, however, to demonstrate that at least in some NDEs, and probably in most of them, the dualistic nature of human beings plays a major role in the experience. (Tanner, English, Durham, Bolaris, Bloomfield, Miller, Beckett, Cherry, Gibson, and Gibson, 1998, p. 63)

Other theories that explain the near-death experience as a real occurrence where some aspect of the human personality, whether it be

a soul, a spirit, or a consciousness, can detach itself from the physical body at death tend to fall into the categories of religious and psychological. These explanations include such factors as chakras that connect interpenetrating bodies to one another that eventually provides access to nonphysical bodies (Ring, 1981), a shift of consciousness from this world to another domain where a person is reunited with his or her total self (Ring, 1980), and an element of human personality capable of surviving death (Grosso, 1981). Other explanations include the Mormon theological explanation of the NDE as a real occurrence that is described by common elements in typical near-death experiences (Lundahl and Widdison, 1983), a systematic theory that describes the NDE as a developmental process (Lundahl, 1993), and the use of attribution theory for explaining the causes of NDEs (Norton and Sahlman, 1995).

The biological, mental, psychological, and social explanations have been concerned with explaining the NDE as a phenomenon caused by factors subject to scientific study and analysis, while the real-occurrence explanations have tended to concentrate more on factors that do not lend themselves to easy scientific analysis. Corroborative NDEs tend to fall in a middle ground where some scientific work is possible. The biological, mental, psychological, and social explanations have received considerable attention from the scientific community, while the real-occurrence explanations have been largely ignored, probably because they are considered anecdotal and cannot be repeatable experiments, they are difficult to measure and test, and they are not in the mainstream of materialist natural science. To this point corroborative NDEs have not received much attention from the scientific community. As their cumulative evidence becomes more obvious they will undoubtedly receive increased research effort from various groups.

The attempts to explain the NDE as a biological, mental, psychological or social phenomenon have failed to do so. These explanations either fit only a minute proportion of the reported near-death experiences or else they describe experiences other than true NDEs (Becker, 1982; Gabbard and Twemlow, 1986; Grosso, 1981; Moody, 1975; Osis and Haraldsson, 1977; Ring, 1980; Sabom, 1982; Sabom and Kreutziger, 1978; Woodhouse, 1983). The explanations of the NDE as a real occurrence other than possibly Grosso's (1982) *archetype of death* have received scant notice or serious evaluation.

Today, the NDE still lacks a scientific explanation acceptable to the scientific community despite the fact that considerable data have been accumulated on the phenomenon for almost a quarter of a century. Physicians and others continue to generate what they hope will be a

model or explanation of the NDE that will stand up to scientific scrutiny, so far unsuccessfully. An interesting case in point was exhibited in the Fall, 1997, issue of this Journal. The entire edition was devoted to an article by Karl Jansen (1997a) entitled "The Ketamine Model of the Near-Death Experience: A Central Role for the N-Methyl-D-Aspartate Receptor," and to the responses by other medical practitioners and researchers to his article. In his article and in his response to the commentaries of others, Jansen (1997b) argued that his ketamine theory might explain NDEs and eliminate the need to ascribe NDEs to some spiritual out-of-body event. Most of his respondents were favorably impressed with Jansen's work. Then, just before publication of that issue of the Journal, Jansen forwarded a postscript which was added as the last note in the publication, in which he wrote:

> I am no longer as opposed to spiritual explanations of near-death phenomena as my article and this response to the commentaries on it would appear to suggest....
>
> My forthcoming book *Ketamine* will consider mystical issues from quite a different perspective, and will give a much stronger voice to those who see drugs as just another door to a space, and not as actually producing that space. After 12 years of studying ketamine, I now believe that there most definitely is a soul that is independent of experience. It exists when we begin, and may persist when we end. Ketamine is a door to a place we cannot normally get to; it is definitely not evidence that such a place does not exist. (1997b, pp. 94–95)

A striking example of near-death research oriented to possible NDEs of a corroborative nature is the recent work of Kenneth Ring with the blind. In this research, Ring, together with his collaborator, Sharon Cooper, interviewed thirty-one blind persons who had undergone an NDE or an out-of-body experience (OBE). His research is of extreme importance to the near-death research community, and many of his conclusions bear directly on the premise of this paper. Some of his research is reported in the Winter, 1997, issue of this Journal (Ring and Cooper, 1997), in which he wrote:

> Our findings revealed that blind persons, including those blind from birth, do report classic NDEs of the kind common to sighted persons; that the great preponderance of blind persons claim to see during NDEs and OBEs; and that occasionally claims of visually-based knowledge that could not have been obtained by normal means can be independently corroborated. (p. 101)

Ring and Cooper have since elaborated on this work in a book concerning persons who were blind and had NDEs (1999).

The major problem with the majority of scientific explanations of the NDE in the past has been their attempt to use a material cause to describe what may, in fact, be a spiritual phenomenon. This has caused "hard science" investigators to rely on techniques that work fairly well in describing our physical universe, but seem unable to explain adequately what may be a different kind of world or universe.

The Dilemmas of NDE and Physics Research

Those involved in NDE research, as noted above, continue to come up against the dilemma of how to explain the NDE in terms of physically known factors when spiritual or "otherworldly" factors keep intruding. The other research field where this is also true is in the area of modern physics. Using the available tools of modern physics and astronomy—such as atom smashers, earth based telescopes, the Hubble space telescope, radio telescopes, space probes, electron microscopes, and computers in conjunction with advanced mathematics—physicists and cosmologists have done a remarkable job of explaining much of what we know about the earth and the surrounding universe. As their knowledge increases, however, so do their questions. The most troublesome of these are questions of ultimate cause.

This dilemma of the physicists was expressed by Stephen Hawking in this manner: "The whole history of science has been the gradual realization that events do not happen in an arbitrary manner, but that they reflect a certain underlying order, which may or may not be divinely inspired" (1988, p. 122). Physicists call this characteristic of the universe, that seems delicately tuned to support life, the *anthropic principle*. The dilemma posed for physicists by the anthropic principle can be illustrated by a few examples.

To explain many of the known phenomena in the universe the mathematics of physics has determined that there are numerous fundamental constants in nature, which if they were slightly different, would eliminate the possibility of life. Paul Davies (1984) pointed out that if, for example, the nuclear forces which bind neutrons, protons, and electrons together were two or three percentage points different, then during the big bang the chemistry would have been altered, and stars and our sun as we know them could not exist. Similarly, if the gravitational constant—which describes the force of gravity—were stronger, then planets would light up and become stars, or they would further collapse, and no life would be possible. If the gravitational constant

were weaker cosmic expansion would have dissipated the primordial materials before gravity could gather them together into planets, stars, and galaxies (Ferris, 1997).

The fundamental building block of all life is carbon. Our bodies are mostly carbon and water. A problem for physicists is how the carbon got here. During the big bang, the primary elements in existence were hydrogen and helium. Ultimately, as the universe cooled during expansion, the hydrogen and helium were compressed by gravity into spiral matter and then into spherical balls. As gravity played its role, the compressed gases in the spheres heated up until they reached the temperature at which atomic fusion takes place. This started with hydrogen nuclei combining to form more helium.

Under certain circumstances three helium nuclei can fuse to form carbon, though the simultaneous reaction of three helium atoms is extremely unlikely. It turns out, though, that there is a resonant energy at which they will react, and this energy is precisely tuned to match the thermal energy at which most stars burn. Though the carbon would be expected to be converted by collision with another helium nucleus to form oxygen, thus eating up all the carbon, there is another resonance, which again is precisely tuned to the thermal energy of most stars, that prevents the carbon from turning into oxygen.

However, this carbon is trapped in distant stars, leading to the question of how it got to our earth. Fortunately, over the life of stars, as they ultimately burn up their fuel, many of them explode and scatter their dust throughout the universe. This stellar dust ultimately reached our stellar system where it was gathered by the gravity of our sun to form our earth; hence the necessary carbon for life (Davies, 1995). This kind of serendipitous chain of events led one physicist, Fred Hoyle, to state: "The universe is a put-up job" (Davies, 1995, p. 118).

Examples of this type could be expanded almost indefinitely (Schroeder, 1992). For example, if the earth were a little closer to the sun it would scorch all life, whereas if it were a little farther away it would freeze all life. The earth's orbit around the sun is nearly circular, unlike that of Mars which is elliptical. The annual variation of the earth's distance from the sun is only three percent of the total distance; hence its temperature is stable. Our modest temperature variation, further moderated by the 23-degree tilt of the earth in its rotation, is just right to keep water liquid under most conditions required for life. If the ratio of nitrogen to oxygen in our atmosphere were significantly less, then most lightning strikes would result in essentially unstoppable conflagrations. If the ratio were significantly greater, then life as

we know it would not be possible. If the density of ice were greater than water, as happens with most other materials when they change from liquid to solid, then it would sink in water and the oceans would become largely ice.

The physicist's dilemma, then, is how to explain these multiple and rare circumstances which point to an anthropic universe and earth. It is similar to the dilemma of near-death researchers who keep trying to explain the phenomenon without giving credence to otherworldly explanations. Physicists, like near-death researchers, try desperately to describe ways in which the universe came to be without relying on some guiding intelligence. They are equally inventive to those scientists laboring with the NDE dilemma, and most of their arguments and theories are equally deficient. The purpose of this article is to explore these two analogous dilemmas and to consider some possibilities for cooperation in the two fields that places greater emphasis on otherworldly answers.

The Nature of the Essence or Spirit Body

One investigator who has attempted a marriage between some of the principles of modern physics and the findings of near-death researchers is Kenneth Arnette. In 1992 he proposed a theory, drawing upon some possible parallels with modern physics, that lent support for the idea that humans beings are composed of both a physical body and an "essence" that survives death. In 1995 he expanded upon his theory of essence, proposing an electromagnetic essence and suggesting other parallels between NDE observations and theories regarding the nature of the universe. More recently he extended his model to include neuroanatomic and neurophysiologic aspects of the interaction between essence and the brain (Arnette, 1999).

In 1983, Craig Lundahl and Harold Widdison outlined an explanation of the NDE based on theological theory. This explanation described the two bodies, or duality of the individual, as a person consisting of a physical body and a spirit body, or essence. The explanation stated that upon death the spirit that contains the human personality disengages from the physical body and lives and moves immediately from this universe to a spirit world (another universe), or from one sphere of existence to another. The next sphere is invisible or imperceptible to those in physical form. The spirit body is composed of refined matter that is not tangible to the coarser matter on the earth. Among the qualities of the

spirit body or essence is the ability to move at "the speed of lightning" (Widtsoe, 1954). Arnette's theory of essence is a partial reiteration of this theological theory but phrased in scientific terminology.

The Nature of Matter as Defined by Modern Physics

In order to speculate on the nature of an essence or spirit body in terms of physically known phenomena it is necessary to consider briefly the nature of matter, as understood by modern physics. Physicists have long known that all matter consists of atoms, which in turn consist of neutrons, with no charge; protons, with a positive charge; and electrons, with a negative charge. In stable atoms the neutrons and protons, which constitute the nucleus of an atom, are held together by a strong nuclear force and are difficult to separate. The massless electrons are held to the nucleus with a weak nuclear force and may be readily stripped from the atom by high temperature and by chemical reactions.

With the advent of high energy particle accelerators it became possible to break the strong nuclear force by accelerating nuclear particles to high energies and forcing them to collide with target atoms. The resulting collision broke the target atoms apart and allowed physicists to study the particles emanating from the parent atom.

In 1960, physicist Murray Gell-Man theorized that neutrons and protons are each composed of three particles, which he called *quarks*. He theorized the existence of these quarks and three others, for a total of six, as a result of certain symmetries of nature predicted by advanced mathematics. Initially Gell-Mann's theory was viewed with skepticism, but as particle accelerators got more energetic they were able to show that quarks did indeed exist. Protons and neutrons turned out to be made of what were called *up* and *down* quarks, with the proton consisting of two up quarks and one down quark, and the neutron consisting of two down and one up quark. In 1995 the last of the six quarks that Gell-Mann's theory predicted was identified (Ferris, 1997, pp. 213–14).

Quarks reside at different quantum energy levels and can become excited to higher energy levels by eating energy. Quarks are held together by the strong nuclear force. The weak nuclear force works upon a family of particles called *leptons*. Included in the lepton family are the lighter particles such as muons, electrons, taus, and neutrinos. The weak nuclear force is also responsible for causing certain unstable nuclear particles to decay (Davies, 1984).

The general and special theories of relativity, proposed by Albert Einstein in 1905 and in 1915, treated light as a particle, and as such it would be subject to the influence of gravity. This was later proved to be true by observing the bending of light rays from distant stars as they passed a massive body (Hawking, 1988). Contemporary with Einstein, Max Planck proposed that light, X-rays, and other waves could only be emitted in packets called quanta (Hawking, 1988); Werner Heisenberg formulated the famous uncertainty principle (Hawking, 1988); and Niels Bohr generated the mathematics that allowed the development of quantum mechanics (Davies, 1984). Paul Dirac, in the 1920s, worked out the mathematics for an electron that incorporated both quantum mechanics and special relativity (Ferris, 1997). In recent years Richard Feynman developed a set of computations that simplify the mathematics of quantum mechanics. The Feynman method of explaining and computing quantum mechanical reactions schematically showed how, at the subatomic level, the electromagnetic forces between two charged particles can be understood as the exchange or transfer of photons. As two charged electrons approach each other, for example, a photon is discharged from one of the electrons to the other and they scatter apart as a consequence (Davies, 1984).

In Einstein's model, light could be thought of as if it were a particle, and predictive computations made on that basis. In quantum mechanics, light could be thought of as if it were a wave, and predictive computations made on that basis. Both situations are true, but under different circumstances. Indeed, quantum theory makes the definition of matter equally contradictory. Matter behaves as if its properties depend in part on the indivisible quantum links with its surroundings. The question of whether a given object, such as an electron, acts more like a wave or more like a particle is therefore not determined entirely by the electron itself but depends partly on the environment of the electron (Bohm, 1989).

Another theory that has recently come into fashion, and which seeks to explain how various fundamental particles interrelate, is known as *superstring theory*. This theory was developed as a result of computations involving the symmetry of particles and the quantum theoretical mathematics of particle spin. In superstring theory, particles are nothing more than infinitesimally small pieces of space vibrating with different frequencies. These strings of space particles interact in various ways forming loops and crosses. The resulting attributes give rise to the characteristics of all known particles, as well as many currently unknown particles.

In 1974, John Schwarz and Joel Scherk completed some calculations that showed that string theory *might* be the way to a fully unified account of all particles and forces, *including* a term that linked gravity inextricably to the theory (Hawking, 1988). This was the first hint that a method might be found that included gravity as a part of quantum theory. Physicist Edward Witten, when he heard of their work, said that "this was the greatest intellectual thrill of my life" (Ferris, 1997, p. 221).

In 1984, Schwarz and Michael Green further advanced the mathematics of strings by using some calculations known as supersymmetry, which eliminated many anomalies that had plagued superstring theory to that point. Their work was sufficiently compelling that Witten joined them in writing a book (Green, Witten, and Schwartz, 1988) that attracted many other researchers to this work (Ferris, 1997).

Superstring theory comes mainly in two varieties, one with twenty-six dimensions, and one with ten dimensions. The mathematics is very complex, and most scientists work on the ten-dimensional variety, since its mathematics is simpler. One of the complexities of the theory is that it predicts literally hundreds of particles, most of which have not yet been discovered, and probably will not be for years, since the energies required to find them experimentally are enormous, exceeding the capabilities of presently existing particle accelerators. One of the strongest objections to the theory is that we will never be able to demonstrate experimentally whether or not it is true. It is hypothesized that many of the predicted particles are indicative of the universe in its first few microseconds of life, while the energy levels were extremely high, before most of the energy froze into mass of the type we know today. If this is true, then string theory gives us a glimpse of how the universe evolved from the big bang. This is, of course, if the universe, as is now widely accepted, did originate in a big bang that occurred in a *singularity*, a term coined by physicists to explain a state where the current laws of physics do not apply.

One of the major efforts of researchers is to explain how the supposedly ten dimensions (or twenty-six), which superstring theory suggests the universe started out as, were compressed down to the four that we now know. Although the mathematics suggests a large number of initial dimensions, it is difficult to describe any physical processes that would reduce them to our present three spacial dimensions and one dimension of time. A number of theories have been proposed, but definitive work has yet to be agreed upon in the physics community.

From these various depictions of particle physics, it is clear that any attempt to define essence or spirit matter in terms of one of the particle descriptions would be premature at best. One might suggest, for example, that the spirit or essence of living beings consists of quarks. Then one would have to explain how the quarks are maintained as stable entities. Perhaps essence or spirit might be described as leptons, since leptons are only bound by weak neutron forces. Again, one is faced with the problem of how their stability is maintained as independent entities in our environment. Or, they might be described as photons of light acting as some type of energy field; but how do the photons retain themselves in a confined boundary such as a living body? We can suppose that essence or spirit might be particles of space vibrating in a manner specified by superstring theory; but what particular type of particles? Even more speculative, one could suppose that the essence or spirit body incorporates dark matter (Kazanis, 1995), a concept we will discuss further below.

Under these circumstances it would seem sufficient to point out that there are a number of possibilities that might lead to a better understanding of the essence or spirit described by those having an NDE. It would be useful for scientists working in the field of NDE research and for scientists working in the field of modern physics to combine their knowledge and effort in a search for answers posed by the dilemmas in their respective fields.

The Nature of Essence or Spirit as Described by Those Having an NDE

Let us now examine how those having had an NDE explained what their otherworldly bodies consisted of. The near-death experiencers quoted below described their spirit bodies or essences as a body of matter or energy, using such terms as a body of energy, a body of light and fine matter or material, a body transmitting light, and a body that is a source of energy or power for the physical body.

A Body of Light

Description 1: Then I felt a surge of energy. It was almost as if I felt a pop or release inside me, and my spirit was suddenly drawn out through my chest and pulled upward, as if by a giant magnet. (Eadie and Taylor, 1992, p. 29)

Description 2: "What did it [spirit body] feel like?" Margaret thought for a moment. "It didn't feel like air either... energy!" (Gibson, 1992, p. 228)

Description 3: I was still in a body—not a physical body, but something I can best describe as an energy pattern. If I had to put it into words, I would say that it was transparent, a spiritual as opposed to a material being. (Moody, 1975, p. 45)

Description 4: All the emotional pain that I had been feeling was gone. I looked at my hand, and I saw a hand, but... it had an aura around it. It wasn't the same hand as an earthly hand. There was an energy field that defined its shape. (Gibson, 1992, p. 228)

Description 5: Looking at my hands I could see that they were white and they glowed—and I was dressed in a glowing white garment. I could feel the energy coming from me. It was coming from every part of my body. (Lundahl and Widdison, 1997, p. 108)

A Body of Light or Fine Matter

Description 6: I felt myself going—separating from my heavy sluggish body. (Fenimore, 1995, p. 89)

Description 7: I had the sense of becoming less dense, as though I had lost twenty or thirty pounds. (Brinkley and Perry, 1994, p. 9)

Description 8: I looked at my hand. It was translucent and shimmering and moved with fluidity, like the water in the ocean. I look down my chest. It, too, had the translucence and flow of fine silk in a light breeze. (Brinkley and Perry, 1994, p. 9)

Description 9: My new body was weightless and extremely mobile. (Eadie and Taylor, 1992, p. 30)

Description 10: [My spirit body was] very thin, very delicate. Very light. Very very light. (Top and Top, 1993, p. 39)

A Body Transmitting Light

Description 11: There was a bright beam of light around my spirit body. (Gibson, 1994, p. 136)

Description 12: [He saw his hands] to be composed of light with tiny structures in them. He could see the delicate whorls of his fingerprints and tubes of light up his arms. (Moody and Perry, 1988, p. 10)

Description 13: But it was without the bulk I normally felt in my earthly body. I felt light, and I also felt as though I had light around me. When He placed me back in my body, it was as if this light transparent something was entering a bulky body. (Gibson, 1994, p. 180)

A Source of Energy or Power for the Physical Body

Description 14: I was a dual personality; on the bed lay my dead body of flesh and bones absolutely lifeless and dead. But my spirit in the same image stood before that bed, freed from all pains filled with new life and ambitions and new hope to live. Now I understood that it is the spirit that gives the power to the mortal body of flesh and bones to function and keep alive. (Lundahl and Widdison, 1997, p. 107)

Description 15: [The spirit] is the energy that gives the body life and power. (Eadie and Taylor, 1992, p. 66)

Other NDErs have used the terms of electricity, waves, charge, or vibrations. They also give descriptions that demonstrate elasticity and porosity of the spirit body or essence. The following are examples of NDE descriptions that use these terms:

Electricity

Description 16: The body's cumbersome weight and coldness were abhorrent. I started jerking around inside it as though many volts of electricity were pulsing through me. I felt the pain and sickness of my body again.... I had become a prisoner to the flesh again. (Eadie and Taylor, 1992, p. 124)

Waves or Charge

Description 17: [My "being"] felt as if it had a density to it, almost, but not a physical density—kind of like, I don't know, waves or something, I guess: Nothing really physical, almost as if it were charged, if you'd like to call it that. (Moody, 1975, p. 48)

Vibrations

Description 18: We began to move upward. I could hear a hum as my body began to vibrate at a higher rate of speed. We moved up from one level to the next, like an airplane climbing gently into the sky. (Brinkley and Perry, 1994, p. 25)

Description 19: Several times during the recuperation time, it seemed that I started to leave my body again. There was vibration, and I could feel myself leaving. (Gibson, 1994, p. 136)

Description 20: My soul was disconnecting from my body with a hum that kept growing louder, rising to a whine as the vibration of death pulled me deeper. (Fenimore, 1995, p. 90)

Elastic or Porous Spirit Body or Essence

Description 21: Then I discovered that I had become larger than in earth life.... I am somewhat smaller in body than I like to be, but in the next life, I am to be as I desire. (Lundahl and Widdison, 1997, p. 113)

Description 22: The "body" leaving me was not exactly in vapor form, yet it seemed to expand very slightly once I was clear of me. It was somewhat transparent, for I could see my "other" body through it. (Rogo, 1989, p. 71)

Description 23: ... she became fascinated by a strange sensation in her hands. They were expanding, painlessly, beyond their normal size. (Harris and Bascom, 1990, p. 20)

Description 24: Again, I reentered through the top of the head, feeling the need to shrink and then squeeze back into the tight form [my] body offered. (Atwater, 1988, p. 37)

The forgoing NDEr descriptions suggest that the spirit body or essence is characterized as a very fine substance that has elasticity and porosity and consists of a form of energy and displays light. It is also associated with electricity, waves, charge, and vibrations. These descriptions give some indication of a body or essence that results from a physical change at death and has the special properties of matter, although it is a different substance with a different set of properties than those of the physical body. From the General Theory of Relativity, it is known that matter and energy are interchangeable. Although the precise nature of a spirit or essence cannot be guessed at in terms of modern physics, the NDE descriptions quoted above do provide a crude understanding that the spirit or essence consists of some form of matter/energy. Further research in this important area is very much called for.

The NDE Tunnel

Nothing is as pervasive in the near-death literature as the descriptions of the "tunnel." Although the descriptions vary somewhat, the idea that the spirit bodies of NDErs traveled at great speed to some distant place through some kind of a tunnel begs comparison with the *black holes*, *multiple universes*, and *wormholes of* the physicists. Before we show a sampling of the NDE descriptions of the tunnel it is useful to review the history and evidence for black holes, multiple universes and wormholes.

Black Holes

Using Einstein's model for light it is possible to postulate a black hole. As stars burn their fuel—the fusing of hydrogen and later helium—the fuel becomes depleted, over the millennia, and the stars burn less energetically and the temperature drops. As the temperature drops, gravity begins to take over and the stars shrink in size. Under certain conditions the star-furnace sputters and gravity causes the remaining mass to collapse on itself in a giant implosion. During the collapse of what was a star, the density of the remaining mass gets ever greater as if it were being squeezed by a giant vise. Depending upon the initial mass of the star, the density may become sufficiently great that the speed of light is less than the escape velocity of light from the remaining mass, which by this time would have been squeezed from the size of a sun essentially to a mere point. Under these conditions light could not escape and a black hole would have been created.

These initial ideas on a black hole grew out of the work of many physicists, starting with the work of the Swiss-American astronomer Fritz Zwicky 1930s and 1940s, when he first identified exploding stars or *supernovae*, and then neutron stars. The hypothetical neutron stars were massive spheres of neutrons pressed in upon themselves by enormous gravity (Thorne, 1994). Lev Davidovich Landau, working in Moscow between arrests, smuggled a paper out of Russia in 1937 that gave credence to the neutron star theory and started Robert Oppenheimer working on the neutron star theory. Oppenheimer showed that stars that began with a mass between 1.5 and 3.0 times the mass of our sun could, as their fuel burned up, collapse and become neutron stars, with a radius of a few miles (Thorne, 1994). In 1956 John Archibald Wheeler began work on neutron stars that led ultimately to mathematical proof that, for stars starting with a mass much larger than that required for a neutron star, gravity collapse would result in what he termed a black hole (Thorne, 1994).

Initially it was thought that nothing could escape from a black hole, including light; thus it could never be detected, but only theorized. In the 1970s Hawking and other scientists showed, through calculations based on the second law of thermodynamics, that black holes, in fact, are not totally black (Hawking, 1988), but rather emit certain forms of radiation such as gamma rays. Unfortunately those emissions are not strong enough to be detected for distant black holes. Black holes might be deduced by observing otherwise unexplained gravitational effects on distant stars, but this was also very speculative.

After Hawking's original computations on the leakiness of black holes, in a brilliant expansion of that idea, he demonstrated that, given enough time, the mass of black holes would also gradually decrease through the loss of radiation. If no further mass were fed into the hole, eventually the mass would be insufficient to keep space-time wrapped around itself, and the hole would explode in a puff of x-rays (Ferris, 1997).

In 1975 Hawking identified a star, Cygnus X-1, that because of its rotational effects seemed to be rotating around a massive object that could not be seen (Hawking, 1988). It was also emitting large amounts of x-rays. Both of these phenomena suggested a black hole. Black holes, then, which started as theoretical constructs, are well accepted today in the scientific community, and astronomers appear to be gathering experimental evidence of their existence.

Multiple Universes

The multiple universe theory was developed by physicists to rebut the argument that our universe is so uniquely arranged for life that God must have had a hand in it. According to this point of view, there is an infinite number of universes, of which ours is but one. Each of these universes is unique in its own way, having characteristics different from ours. Although most of these universes would not sustain life, since there are an infinite number of them, a few would, ours being one. Thus, life in our universe is not the result of design by God, but is merely the result of happenstance. An infinity of universes would, by definition, include one with the characteristics that ours has. Although what we know of our universe seems highly selective and unusual, if we could see all of the universes we would recognize that ours is not that unusual, given the many different ones that exist (Davies, 1984).

A variation on this theme was produced by physicist Hugh Everett in 1957 as a result of his work in quantum physics (Davies, 1984). He theorized that whenever a quantum transition takes place in the universe, another universe is formed. When uncertainty is involved, for example, and a measurement is performed to determine, as in a famous hypothetical example, whether Erwin Schrödinger's cat is alive or dead, the universe divides in two, one holding a live cat and the other a dead cat. This occurs throughout the universe countless times each second. Thus there are numerous universes with copies of each of us living in it, each copy of us assuming that he or she is unique.

Another variation came out of Andrei Linde's recent work on quantum genesis. Linde described a process called *chaotic inflation*, which

suggests that our universe began as a bubble that ballooned out of the space-time of a pre-existing universe (Ferris, 1997).

Since all we can see and measure is our own universe, the multiple universe theory must remain just a theory. There may, indeed, be more than one universe, but it can never be proven one way or another. More to the point, it is just as logical to argue that God created other universes that have purpose, order, and design, just as ours does, as it is to argue that an infinity of universes were created by happenstance with no input from any creative agency.

Wormholes

Wormhole theory was built upon the back of black holes and multiple universes. In effect it was speculation built upon speculation. The theory started almost as a science fiction writer's dream of connecting two black holes together from different universes, or from different space-time bubbles in the same universe. By means of this imagined connection, space travelers could travel almost instantly from one universe to another.

In the mid-1980s Kip Thorne proposed that it might be possible to hold wormholes open in such a way as to make them accommodating to travelers (Thorne, 1994). He postulated the existence of "exotic" material that would, his calculations showed, have negative energy in the wormhole's frame of reference, which would keep the wormhole dilated.

In early 1988, as the result of a phone call from Carl Sagan, Thorne further speculated that an advanced civilization might create wormholes through which travelers could travel through both space and time (Thorne, 1994). Working with Mike Morris and Tom Roman, he postulated a wormhole in which people could "travel over interstellar distances far faster than light" (Thorne, 1994). This type of thinking leads to a paradox illustrated by Timothy Ferris in this hypothetical story:

> A space man could thus enter a worm hole in his living room and return earlier than he had departed. In the process the traveler would have created a copy of himself. In this type of speculation, the copy of the traveler could stop the initial version of the traveler from entering the worm hole, in which case the version of the traveler that stopped the other version would not have shown up to intervene—in which case he would. (Ferris, 1997, p. 101)

Thorne recognized this type of paradox, and he put it this way: "If I have a time machine (worm hole-based or otherwise), I should be able

to use it to go back in time and kill my mother before I was conceived, thereby preventing myself from being born and killing my mother" (1994, p. 109).

Despite these paradoxes, Thorne and others, including Hawking, kept working on the mathematics of wormholes and time machines. The result of that effort may be summarized by a quotation from Hawking:

> Whenever one tries to make a time machine, and no matter what kind of device one uses in one's attempt (a wormhole, a spinning cylinder, a "cosmic ring," or whatever), just before one's device becomes a time machine, a beam of vacuum fluctuations will circulate through the device and destroy it. (Thorne, 1994, p. 521)

In time, Thorne came to agree with Hawking (Thorne, 1994). Most other scientists also reject such versions of time travel. Hawking joked that evidence of the improbability of time travel is demonstrated by "the fact that we have not been invaded by hordes of tourists from the future" (Ferris, 1997, p. 101).

Comparison with NDE Descriptions

From the above it is clear that, aside from black holes, the theory of multiple universes and worm holes is highly speculative. Current theories suggest that if traveler entered a black hole, his or her body, regardless of its particle composition, would implode into other minute particles and be trapped in the enormous gravity of the hole. Since a wormhole is merely a hypothetical expansion of a black hole, a similar fate would befall any traveler brave enough to enter it.

Despite these formidable obstacles, some physicists continue to speculate about the possibility of travel from one universe or one galaxy to another. To tie this speculation to NDEs, let us hear what some of those travelers to another world have to say about their experience:

Description 25: Then I saw this darkness; I felt as though I were traveling through the darkness in . . . in sort of a tunnel. (Gibson, 1993, p. 40)

Description 26: There was a tunnel that went down and off to the right, and that's where the light was coming from. (Gibson, 1993, p. 92)

Description 27: I found myself being drawn toward a bright light that was down the tunnel. (Gibson, 1993, p. 121)

Description 28: There was no fear, and there was a light at the end of the tunnel. The sides of the tunnel, though, had some light, I could see the walls. (Gibson, 1993, p. 172)

Description 29: As I traveled along I remember seeing a light at the end of a large hole, which looked something like an irrigation culvert, but much bigger. (Nelson and Nelson, 1994, p. 155)

Description 30: Suddenly I was aware of a dark tunnel, like a doorway leaving the operating room.... I entered the tunnel and found myself traveling very fast towards the far end.... There was a light at the end of the tunnel. It wasn't blue light, but a warm golden light, very bright. (Nelson and Nelson, 1994, p. 113)

Description 31: I suddenly awakened to the startling realization that I had left my body and was traveling in a giant, dark tunnel or corridor towards a very bright light, brighter than any light I had ever seen. (Nelson and Nelson, 1994, p. 165)

Description 32: I saw a pinpoint of light in the distance. The black mass around me began to take on more of the shape of a tunnel, and I felt myself traveling through it at an even greater speed, rushing toward the light. (Eadie and Taylor, 1992, p. 40)

Description 33: In the darkness a tunnel opened. The walls of this tunnel were grooved like furrows in a freshly plowed field. These furrows ran the length of the tunnel toward the bright light at the end. (Brinkley and Perry, 1994, p. 147)

Description 34: My first memory after losing consciousness was to awaken and realize that I was speeding down a dark tunnel. There was a light at the end of the tunnel, and I was moving toward it. Suddenly I came to the end of the tunnel. (Gibson, 1993, p. 185)

NDEs and Dark Matter

The majority of NDEs are euphorically pleasant experiences, but not all of them. Some are terribly frightening and are every bit as realistic to those experiencing them as are pleasant NDEs. And just as pleasant NDEs seem tailored to the needs of individuals having them, so also do unpleasant NDEs. Some unpleasant NDEs commence in a fearsome manner, and then become more pleasant as the experience unfolds. Others remain fearsome throughout. The most terrifying NDEs appear to be those in which the individuals are exposed to darkness, or NDEs in which the experiencer is attacked by evil-appearing otherworldly beings who seem intent on destroying the intruder into their realm (Gibson, 1996). Let us now consider those NDErs who experience darkness; but before we explore statements concerning travel to the dark world of the frightening NDE, let us review what science knows about dark matter.

The Russian scientist Alexander Friedmann, in 1920, set about explaining Einstein's prediction of a nonstatic universe. He showed that, from far away, the universe looked so similar in all directions as to be nearly homogeneous, and that it was expanding and would continue expanding, or it would collapse on itself according to the total mass of the universe (Hawking, 1988).

In 1929 Edwin Hubble proposed the *Hubble law*, which stated that the farther away a star or galaxy is, the greater will be the red shift displayed in its spectrum (Ferris, 1997). He also developed the *Hubble constant*, which established the rate of expansion of the universe. Later, the Hubble constant was combined with the *deceleration parameter*, which measures the rate at which cosmic expansion slows down, to yield the factor *omega*. If omega is less than one, the universe is destined to expand forever; if it is more than one, it is destined to collapse. If omega is exactly one, the universe is at critical density and will expand forever, at a rate of acceleration that approaches but never quite reaches zero (Ferris, 1997).

Hubble's findings led to the desire to measure the rate of expansion of the universe and attempt to determine omega. This proved to be very difficult, among other reasons, because it required a reasonably accurate account of the total mass in the universe. Cosmologists, therefore, took upon themselves the formidable task of estimating the total mass of the universe (Hawking, 1988), by adding up the masses of all the stars we can see in our galaxy and other galaxies. Simultaneous with this work, other scientists were measuring the rate of expansion by the red shift and brightness of stars. Still others were measuring gravitational effects that stars had on each other, by observing their orbits in the galaxies. The gravitational effects turned out to be greater than expected from the calculated masses of the observed stars, and the total estimated mass of the visible universe turned out to be much less than required to agree with the estimated value of omega. As the result of such observations, and similar ones concerning galaxies themselves, it was concluded that there must be a large amount of matter in the universe that cannot be observed directly. Calculations showed that the visible universe contained only about ten percent of that required to reach an omega approaching the critical value of unity, which many physicists at that time estimated was its value (Ferris, 1997).

In 1933, Zwicky discovered that the outlying galaxies in the Coma cluster were moving much faster than they would be if its mass were limited to that of the visible galaxies in it. From these gravitational effects, Zwicky calculated that Coma would need ten times as much

matter as had been observed. To account for this anomaly he coined the term *dark matter* (Ferris, 1997). In the late 1950s, Vera Rubin studied the rotational and gravitational effects of large spiral galaxies, and found that stars near the outer disks of galaxies were traveling faster than the gravitational effects of the visible mass would allow (Ferris, 1997). The only way to account for this faster-than-expected rotation was if unseen mass were included in the galaxy. Many other similar findings followed Zwicky's and Rubin's initial work, and physicists then estimated that the universe must be 90 percent dark matter (Ferris, 1997).

Recent work by astronomers has concluded that dark matter is much less than 90 percent, based on observations of distant exploding stars, or supernovae, which showed that galaxies about halfway back in cosmic time were receding at velocities comparable to objects of more recent epochs. This led to the conclusion that the universe is not slowing its expansion, as would be the case if it contained enough mass to have an omega of 1 or greater. Based on these findings, some estimates place the mass of the universe as only 20 to 30 percent of the amount required for an omega of 1. Saul Perlmutter reported in the 1998 meeting of the American Astronomical Society that there is not enough mass in the universe for its gravity to slow the expansion, which started with the Big Bang, to a halt; and that therefore the universe, instead of being about eight billion years old, may be as old as fifteen billion years (Matthews, 1998).

The next question after determining that the universe contains dark matter was what dark matter is made of. The only dark matter of significance that physicists had confidence in were black holes and neutron stars, but these did not seem sufficient to add up to the amount needed. Postulated candidates included baryonic matter, such as neutrons and protons, and massive cold gas clouds. In addition, physicists speculated that nonbaryonic matter such as leptons might be dark matter (Ferris, 1997). The problem with leptons, such as electrons and neutrinos, is that they are thought to have no mass. The fact that a neutrino has no mass has never been proven, however, so physicists have been theorizing that these ghostly particles, which are extremely difficult to detect, may have mass and are therefore candidates for dark matter (Ferris, 1997).

To further define what dark matter consists of, physicists have speculated that there may be *hot dark matter* and *cold dark matter*. The hot dark matter are particles that at the time of the big bang were moving at velocities close to the speed of light, while the cold dark matter are particles that were moving more slowly. The leading hot dark matter

candidate is the neutrino. One group of physicists has proposed that the universe might contain a mixture of 30 percent hot and 70 percent cold dark matter (Ferris, 1997). These estimates and theories about the types and mixtures of dark matter will undoubtedly change as the result of the new astronomical findings concerning the rate of expansion of the universe. Malcolm Longair put our current ignorance about dark matter in perspective:

> Most of the matter in the universe is probably in the form of dark matter and thus this matter is likely to have a profound impact upon the formation of galaxies.
> ... I would caution, [however], that the whole story must be regarded as provisional because the basic physics is far from secure. (1989, p. 199)

From the above discussion, it seems clear that the majority of physicists agree that dark matter exists, but they are very uncertain as to what it consists of. For these reasons any assignment of dark matter as an explanation for certain aspects of the NDE must be considered highly speculative. Nevertheless, the continual reference to some type of a dark world seen by many of those having an NDE warrants exploration. Ring (1980) labeled the third stage of the near-death experience *entering the darkness*. Ring described the darkness as typically characterized as a completely black or dark dimensionless space, usually described by NDErs as a space before reaching the external world of light. NDErs describe this space as dark, darkness, blackness, fog, or totally black (see particularly Descriptions 35–40, 42–44, and 47), and lacking light (Descriptions 40 and 43) but having mass, energy, and negative energy and intelligence (Descriptions 40, 41, and 43). Some describe it as a space on a different level (Description 39), or as occupied by numerous beings who are gray and filled with darkness (Descriptions 42–47). We present the following descriptions to provide the reader with illustrations of a world of darkness as seen through the eyes of those who experienced it. These descriptions of another world are no more irresolute as to their reality or unreality than is the world of the physicist trying to explain dark matter; indeed, one could argue that, since they are first-hand experiences, they may be more authentic.

Darkness, Blackness, or Fog

Description 35: I looked ahead into the darkness. (Brinkley and Perry, 1994, p. 8)

Description 36: I saw, off in the darkness somewhere,...(Gibson, 1992, p. 225)

Description 37: ...a darkness, it was a very darkness...(Ring, 1980, p. 55)

Description 38: Immense blackness flooded over me like a rapid, dense fog. The darkness was so absolute that nothing was visible, and it seemed that nothing ever could be visible in it. (Wallace and Taylor, 1994, p. 90)

Description 39: There was...I can only describe it as total black. There was a changing level, it was like going from one level to another. (Sutherland, 1992, p. 7)

Description 40: I was immersed in darkness.... The darkness continued in all directions and seemed to have no end, but it wasn't just blackness, it was an endless void, an absence of light.... [later] In the final split second before my feet touched down, I got only a lightning glimpse of my destination—of crowds, of what looked like thousands upon thousands of other people massed below. I landed on the edge of a shadowy plane suspended in the darkness, extending to the limits of my sight.... The place was charged with a crackling energy...The foglike mist had mass—it seemed to be formed of molecules of intense darkness—and it could be handled and shaped. It had life, this darkness, some kind of intelligence that was purely negative, even evil. (Fenimore, 1995, pp. 103, 105–107)

Description 41: Positive energy is basically just what we would think it is: light, goodness, kindness, love, patience, charity, hope, and so on. And negative energy is just what we would think it is: darkness, hatred, fear (Satan's greatest tool), unkindness, intolerance, selfishness, despair, discouragement, and so on. (Eadie and Taylor, 1992, p. 57)

Beings in the Darkness

Description 42: It's a dusky, dark, dreary area, and you realize that the area is filled with a lot of lost souls, or beings...(Flynn, 1986, pp. 82–83)

Description 43: The darkness was more than a lack of light; it was a dense blackness unlike anything I had known before.... When I was in the black mass before moving towards the light, I felt the presence of such lingering spirits. (Eadie and Taylor, 1992, pp. 38, 84–85)

Description 44: As I looked around, there seemed to be an endless sea of agonized souls floating in the fog. As some of them passed close by me, I could hear them moaning and groaning. The fog was so thick I could only make out their dim outlines. (Tooley, 1997, p. 8)

Description 45: I don't know what they were, but they looked washed out, dull, gray. (Moody, 1977, p. 19)

Description 46: All whom I saw seemed Caucasian, but there was a visible darkness about them that wasn't an exterior element, like skin color. The darkness emanated from deep within and radiated from them in an aura I could feel. (Fenimore, 1995, p. 107)

Description 47: During this period I became aware that I was conscious, but I was enveloped in total darkness. It was pitch black all around, yet there was a feeling of movement. My conscious self assured me that I was in the form of a spiritual body.

A male voice spoke to me... [and] said: "You have a choice. You can stay here, or you can go back. If you stay here, your punishment will be just as it is, right now. You will not have a body, you will not be able to see, touch, or have other sensation. You will only have this darkness and your thoughts, for eternity." (Gibson, 1993, p. 133).

Cities of Light

There are numerous examples in the literature of people having a near-death experience who traveled to some distant place and saw a beautiful world which many of them characterized as *cities of light*. In most instances those NDE travelers were under the impression that when they reached this glorious place, they were in a different dimension.

We have already discussed the various multiple universe theories of the physics community. Although it is not possible to make close parallels between the cities of light described in NDEs and the physicists' multiple universes and travel between universes or galaxies, still, there are sufficient similarities to warrant examining some of the NDE descriptions. Certainly the NDE descriptions are less bizarre than are the physicists' descriptions of an infinite number of universes with replicate copies of each of us.

As illustrated in the passages quoted below, NDErs have described other cities of light, kingdoms, realms, planes, levels, or dimensions. At the end of the dark tunnel is another universe or dimension usually reflected by the light and beauty at its entrance.

Cities of Light

Description 48: I moved closer to the lights and realized they were cities—the cities were built of light. (Ring, 1985, p. 72)

Kingdoms

Description 49: He [a personage] then took me to the next kingdom which was far more beautiful in glory and order than the former two. (Lundahl and Widdison, 1997, p. 167)

Realms

Description 50: Our spirits slip from the body and move to a spiritual realm. (Eadie and Taylor, 1992, p. 83)

Description 51: First He [Jesus] had shown me a hellish realm, filled with beings trapped in some form of self-attention. Now behind, beyond, through all this I began to perceive a whole new realm! (Ritchie and Sherrill, 1978, p. 68)

Planes

Description 52: I was halfway between two planes of existence, and could see both. (Nelson, 1994, p. 120)

Levels

Description 53: We moved up from one level to the next, like an airplane climbing gently into the sky. (Brinkley and Perry, 1994, p. 25)

Description 54: My guide would not permit me to pause much by the way, but rather hurried me on through this place to another still higher but connected with it. It was still more beautiful and glorious than anything I had before seen. To me its extent and magnificence were incomprehensible. (Lundahl and Widdison, 1997, p. 166)

Dimensions

Description 55: It was as if I was in a different dimension or time zone. (Nelson, 1994, p. 153)

Description 56: My spiritual eyes were opened to another dimension in the darkness. (Fenimore, 1995, p. 89)

Description 57: Suddenly I started going through dimensions. There is no way to describe what happened. I was moving through our physical dimension into another one. (Sorensen and Willmore, 1988, p. 90)

NDE descriptions suggest that the level of the universe or dimension a person travels to upon death is dependent upon the amount of energy

levels and frequencies of light in the individual spirit, which NDE descriptions indicate are based on human behaviors while on earth. That individuals have different levels of light is suggested by the following NDEr descriptions:

Description 58: When I first entered the dark prison, my vision took in only the things and the people in the realm of darkness. But once I had taken enough light in from God and Jesus, my spiritual eyes were opened to another dimension in the darkness. Now I could see that beings of light were all around me. (Fenimore, 1995, p. 143)

Description 59: My feet and hand were perfect and whole. They radiated this glistening, beaming light, and I looked at my grandmother and saw that her light was brighter than mine. (Wallace and Taylor, 1994, p. 99)

Space-time and Speed of Travel

Perhaps the area of apparent closest correlation between those experiencing NDEs and the study of physics has to do with the measurement of time. Almost universally among those who say they traveled to another world is the thought that time does not work the way it does in our everyday world. Another area which has some similarities, as well as some difficulties, involves the speed of travel to these other worlds.

Let us first consider the physicists' understanding of space-time and speed of travel. Science is still guided by the general theory of relativity, and Einstein's equation $E = mc^2$ is the basis, along with quantum theory, for most of what occurs in nature. By Einstein's equation of the equivalency of mass and energy, it is known that the maximum speed achievable in the universe is a constant c, equal to 299,792 kilometers/second or 186,282 miles/second. According to the theory, nothing can exceed that value. Imagine, for example, a spaceship traveling ever faster. As it approaches the speed of light, its mass increases and its length, measured along the axis of its direction of travel, shrinks. The passage of time on board slows. The amount of energy required increases enormously, approaching infinity as it gets nearer to the speed of light. Meanwhile the mass of the ship approaches infinity, its length shrinks to zero, and time on board comes to a stop (Ferris, 1997). For a traveler through space approaching the speed of light, time passes slower than for those remaining on earth.

Einstein demonstrated that time is, in fact, elastic and can be stretched and shrunk by motion. Each observer carries around his or her

own personal scale of time, and it does not generally agree with anybody else's. In our own frame, time never appears distorted, but relative to another observer who is moving differently, our time can be wrenched out of step with his or her time (Davies, 1984).

Equally extraordinary effects afflict space, which is also elastic. When time is stretched, space is shrunk. The mutual distortions of space and time can be regarded as a conversion of space, which shrinks, into time, which stretches; and vice versa (Davies, 1984). Just as time scales change from place to place in a gravitational field, so do the length scales. Rulers change lengths as one moves around. It is impossible with space and time so intimately mixed to have something happen with time that is not in some way reflected in space (Feynman, 1997).

The above discussion should be sufficient to demonstrate that as very high speeds are realized, approaching the speed of light, time does not behave in the same manner as we usually think of it behaving. It is stretchable, depending upon where it is observed, as is space. One could argue, therefore, that someone having an NDE and traveling to a distant location in space could do so with very little time as observed by him- or herself. There are two difficulties with this argument. The first is that when the NDE travelers returned to earth, everyone with whom they came in contact would be very much older. The second difficulty has to do with the distance traveled. Although many of those having an NDE felt that they traveled to a distant location, according to the theory of relativity they could not have traveled faster than the speed of light. The nearest star to us, Proxima Centauri, is about four light-years away. To an observer on earth, therefore, the NDE traveler must have taken four years to travel to the closest star. Many stars, of course, are thousands or millions of light years distant.

There are at least two peculiar circumstances in which science recognizes velocities in excess of the speed of light. One circumstance has to do with the space of the universe, which, since the big bang, has been expanding. It is true that in static space nothing can exceed the speed of light. However, in the cosmological model that many physicists accept, the universe began its expansion with a velocity much greater than that of light (Ferris, 1997). The recent astronomical findings concerning the expansion of the universe will undoubtedly change this model, but the possibility of a velocity greater than light is, at least in some models, an acceptable theory.

A second peculiar situation derives from some of the characteristics of quantum theory and the uncertainty principle. It can be illustrated by a hypothetical experiment in which one particle decays into two particles.

Of the remaining two particles, one has a spin of +1 and the other has a spin of −1. Let us remove one of the particles far away, say two light-years. A physicist measures the spin of the particle near him and finds that it is −1 and he knows, therefore, that the distant particle has a spin of +1. If somehow the near particle has its spin reversed to +1, then the distant particle *instantly* has a spin of −1. For that to occur logic would demand that some sort of signal be exchanged, traveling *instantly* from the near point to the distant point, so that the far particle *knows* that it must reverse its spin. This is one of the paradoxes of science (Ferris, 1997) that Einstein called "spooky action at a distance."

Scientists recently reported a striking example of the experimental verification of this remote spooky action, in two experiments on what was called *quantum teleportation*. Teleportation is a way of transferring the state of one particle to a second using "entanglement," a mysterious connection between objects separated by arbitrary distances. An Austrian group succeeded in teleporting photons of light (Bouwmeester, Pan, Mattle, Eibl, Weinfurter and Zeilinger, 1997), while an Italian group teleported the photons' polarization states (Sudbery, 1997). The state of an object, whether it be an atom, electron, photon, or other entity, is defined by both its quantum characteristics and its classical characteristics. In order to replicate the object both sets of characteristics are needed. The problem in the past, concerning determining the quantum characteristics, was that the measurement itself, by the uncertainty principle, changed the characteristics of the particle.

In the Austrian laboratory, bits of light in one place were destroyed and duplicated in a perfect replica some distance away. This was done by using "entangled" photons, with one photon at the point of origin and the other entangled photon at a distance. A "message" photon was used to transfer information about a crucial physical characteristic of the original light bits or photons. The necessary quantum information was picked up *instantly* by other, distant entangled photons. The classical information required to complete the necessary data for duplication was transferred by a classical channel at the speed of light. Thus, the distant light photons took upon themselves the identical characteristics of the original photons and became perfect replicas. These are the first clearly demonstrated experiments that show the distant spooky action predicted by quantum mechanics. A possible practical application will be in future generations of even faster computers.

Despite these strange instances of something exceeding the speed of light, scientists still insist that in general nothing can travel faster than the speed of light. To do so would violate the principles of relativity.

In the above experiments the distant replica cannot be created faster than the speed of light, since the required classical information travels at that speed, even though quantum information is communicated instantly. Scientists are still at a loss to explain how entanglement works. Nevertheless they do accept that in some magic way quantum information is being transmitted instantly over arbitrary, and in theory enormous, distances, clearly in excess of the speed of light. In wrestling with the quantum theory paradoxes, Ferris postulated that if some of the physicists' theories are true, then:

> We live in a universe that presents two complementary aspects. One obeys locality and is large, old, expanding, and in some sense mechanical. The other is non-local, is built on forms of space and time unfamiliar to us and is everywhere interconnected. We peer through the keyhole of quantum weirdness and see a little of this ancient, original side of the cosmos. (1997, p. 287).

Thus the commentaries of NDErs who claim that time was different and that they traveled at speeds exceeding the speed of light are no more weird than the commentaries of the scientists speaking of the weirdness of quantum theory. Perhaps the NDE travelers are expressing, in their limited understanding, a phenomenon that we shall all someday come to know as the normal part of a new reality. Admittedly, when those having an NDE say that they traveled at speeds close to or exceeding the speed of light, their statements are merely their subjective understanding of a feeling of great speed.

The first feature of the NDE spirit body or essence that we shall discuss is its speed of movement when separated from the physical body. At the point of separation, those having an NDE describe a spirit body that is no longer constricted in movement by the denser or coarser physical world and can travel at great speeds. The following descriptions refer to this feature:

Description 60: [I] found myself traveling very fast towards the far end. I wasn't walking or running, just floating along very fast. (Nelson, 1994, p. 113)

Description 61: I began moving at tremendous speed,...(Eadie and Taylor, 1992, p. 66)

Description 62: We left the hospital room by rising straight up through the roof and then we headed over the surface of the Earth at a very rapid speed. (Ritchie, 1991, p. 21)

Description 63: My speed was tremendous—indescribable. Nothing on earth has ever gone that fast, nothing could. (Wallace and Taylor, 1994, p. 91)

Description 64: I felt as if I was being propelled forward at the speed of light or faster. (Grey, 1987, p. 43)

Description 65: We started off on our journey through space, seemingly with the rapidity of lightning (For I can make no other comparison). (Heinerman, 1978, p. 109)

Description 66: Gradually, you realize . . . you're going [at] at least the speed of light. It might possibly be the speed of light or possibly even faster than the speed of light. You realize that you're going just so fast and you're covering vast, vast distances in just hundredths of a second. (Ring, 1985, p. 57)

The second feature of the NDE related to space-time are descriptions by NDErs of the lack of precise time units such as those found in the physical world. The following passages describe this timelessness:

Description 67: I knew somehow that they were on a time scale different than earth's. (Eadie and Taylor, 1992, p. 31)

Description 68: I have no idea what the time parameters were to this experience. (Nelson, 1988, p. 45)

Description 69: I don't know. I didn't really have a sense of time. (Gibson, 1993, p. 274)

Description 70: You could say it [NDE] lasted one second or that it lasted ten thousand years and it wouldn't make any difference how you put it. (Moody and Perry, 1988, p. 14)

Description 71: It was a different sphere . . . one in which the concept of time is meaningless. (Brown, 1997, p. 202)

Description 72: For what seemed to be endless time, . . . (Ring, 1980, p. 98)

Description 73: I found myself in a space, in a period of time, I would say, where all space and time was negated. (Ring, 1980, p. 98)

Visions of Knowledge

We have already discussed the paradoxes associated with time travel and the skepticism accorded the concept. But while most physicists regard the idea of time travel as fiction, some have advanced the notion as a serious idea, which opens the door to vistas of knowledge from the past, present, and future.

One of the most fascinating aspects of some NDEs is the descriptions of those who said they had almost total knowledge of the universe. They often describe a situation in which they were able to visit different time

periods visually and emotionally much like they do in the life review, and they report this experience was as real to them as life itself, though not necessarily as travel to a past or physical entity such as earth (see Description 76 below). Often these travelers saw both personal and global events in that context. Upon return and recovery from their near-death state most of them forgot much of what they knew in this other world; they remembered only that they had a remarkable experience of complete knowledge.

In Ring's study of blind people who had NDEs he also found individuals who expressed complete knowledge of many things. One of those is quoted below in Description 79. In addition to having knowledge extension beyond earthly experience, many of the blind explained their sight as more than just ocular vision. It was as if they could see in every direction simultaneously and had knowledge or complete awareness in great detail of their surroundings. Ring identified this as a "consciousness that may and indeed must sometimes function independently of the brain." He called this *transcendental awareness*, and he verified that some sighted persons who had undergone NDEs also experienced a similar phenomenon (Ring and Cooper, 1997, pp. 143–146).

A brief sampling of the comments of some of those who said they had extraordinary knowledge follows:

Description 74: I was also aware of pure knowledge. Things went quickly through my mind. I could understand many things. (Nelson, 1989, p. 118)

Description 75: About this time I had an experience that I'll never forget... a feeling of total, total knowledge without asking.... This feeling I had of total knowledge was just that, I knew everything without asking. It was an incredible feeling. (Gibson, 1992, p. 218)

Description 76: Scene after scene of living truth passed through me: history on earth, history of our existence before earth, principles, facts, things that I had had no conception of. I saw them. I experienced them, literally becoming part of each scene. (Wallace and Taylor, 1997, p. 106)

Description 77: I can describe the experience as only ecstasy of a contemporal state in which present, past and future are one. (Top and Top, 1993, p. 132)

Description 78: The past, present, and future seemed accessible on demand. (Brown, 1997, p. 202)

Description 79: I had a feeling like I knew everything... and like everything made sense.... I don't know beans about math and science.... I all of a sudden understood intuitively almost things about calculus,

and about the way planets were made. And I don't know anything about that.... I felt there was nothing I didn't know. (Ring, 1997, p. 111)

Conclusions

Research about near-death experiences and research in the field of modern physics have increasingly encountered analogous dilemmas. These dilemmas have to do with how to explain experimental results and theories in the respective fields without accounting for some spiritual, otherworldly guiding force. Indeed, in the near-death research community attempts to arrive at some scientifically rational explanation that accounts for all of the events known to occur with those having an NDE, and which avoids otherworldly explanations, are nearing exhaustion. Although not as obvious in modern physics, perhaps because of the remarkable accomplishments of physicists and their deserved respect, the search for answers to questions of ultimate cause has sometimes reached bizarre limits.

As research continues in the field of near-death studies, corroborative types of NDEs in which those undergoing the incident see events impossible to be explained in any other way than an out-of-body experience, later verified by others not involved in the NDE, are becoming more numerous in the literature. This type of corroborative experience is forcing a reassessment of research methods and goals. Ring's study of blind persons who had near-death or out-of-body experiences, for example, deliberately sought corroborative evidence concerning the realities of the experiences (Ring and Cooper, 1997, pp. 119–124).

It has become popular in the media and in science-fiction novels to speak of travel through wormholes to distant universes, sometimes going backward or forward in time. There are even those in the near-death research community who speculate on the efficacy of such possibilities. Many of the ideas in these published works derive their origin from some of the theories of modern physics. The concept of multiple universes, as pointed out above, was developed in an attempt to explain the uniqueness of our own universe without accepting the idea that a purposeful force, or a supreme being, provided the guidance and energy to fine-tune many of the fundamental parameters and constants that make life in our universe possible. Other physicists, using some of the ideas from quantum theory, hypothesized an infinity of universes with multiple copies of each of us in many of them.

Wormholes were an extension of the rather abundant data substantiating the existence of black holes. Unfortunately, similar abundant data on wormholes have not been forthcoming, and their existence remains highly speculative. The prospects for time travel, while also hypothesized by some physicists, are best summed up by Hawking, who observed that history is secure for historians since it is very unlikely that any time travelers will be able to change it. Much is known about the fundamental particles that make up our visible universe. Dark, invisible (to us) matter, however, continues to be an important mystery currently plaguing physicists, along with the related problem of the rate of expansion of the universe. Indeed, recent observations of the rapid rate of expansion of the universe has forced theoretical physicists to reconsider Einstein's "cosmological constant," a form of antigravity that Einstein later discarded (Krauss, 1999).

There are numerous other mysteries remaining to be explained, many relating to the nature of still undiscovered particles theorized by superstring theory. "Quantum weirdness," which by symmetry illustrates instant reaction of a distant particle in response to some action by its twin, is, as Einstein characterized it, "spooky action at a distance." The greatest mystery of all, though, persists as an uncertainty as to whether the universe and all that is in it can be explained solely by "natural" forces working their magic by chance, or whether there is a guiding and intelligent force acting as creator. Physicists continue to struggle with the idea of an intelligently created anthropic universe.

Because of the ubiquitous presence of unique constants and phenomena that allow existence of life on this planet, some physicists, like their NDE researcher counterparts, are turning to nonmaterialistic answers to the difficult questions raised by their research. As Hawking put it, "The question remains, however: How or why were the laws and the initial state of the universe chosen?" (Hawking, 1988, p. 173). Knowledgeable science writers are increasingly facing the question posed by Hawking. Gerald Schroeder (1992) compared some of the findings of modern physics with the writings in the Old Testament. Davies (1995) examined many of the dilemmas of science, and pointed out that one of the greatest dilemmas was how to explain the awesome ability of humans, in some mysterious way, to observe and mathematically describe much of what we see. To summarize this point he quoted Freeman Dyson who said: "I do not feel like an alien in this universe. The more I examine the universe and study the details of its architecture the more evidence I find that the universe in some sense must have known we were coming" (Davies, 1995, p. 128).

In this article we have considered these dilemmas of modern science, and we have pointed out key uncertainties in the fields of near-death studies and modern physics. Through illustration of various NDE phenomena we have identified areas of potential overlap between the two fields. As scientists continue to encounter questions of ultimate cause, it would appear that their research could be fruitfully enhanced by a cross fertilization of ideas. It would further seem appropriate to emphasize research with an otherworldly thrust. There is now sufficient evidence in both of the fields to justify more effort in this regard. Perhaps with an openminded sharing of ideas we can ultimately come to a better understanding of our universe and our position in it. We might even begin to make progress with the ultimate questions: Is there some influence beyond the physical world? Is there a purpose to the universe? How did the universe get started? Why are we here? Where did we come from? Where are we going?

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