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**MENTAL STRESS AND PHYSICAL FACTORS IN THE
TERMINAL PHASE OF FATAL AIRCRAFT ACCIDENTS:
A REVIEW OF RELATED SCIENTIFIC LITERATURE,
THE SIGNIFICANCE OF RECOVERED VOICE
RECORDER TAPES, & THE VICTIM'S PERCEPTION OF
INJURY IN THE LAST NANOSECONDS OF LIFE**

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THE ISSUE OF pain and suffering experienced during the terminal moments of fatal aircraft accidents has not been directly addressed in the medical or scientific literature. However, when one listens to the "black box" tapes recovered from military and civilian fatal accidents it is quickly apparent that there is great distress associated with the termination of life, regardless of the abrupt nature of that experience. An appreciation of the physical and psychological events associated with this tragic experience can be achieved through a review of the parallel medical and scientific literature. To meet the test of scientific validity the *Daubert* decision requires that the published literature supports an expert's opinion. The following is an overview of that literature.

The science of psychosomatic medicine, the interrelationship of mind and body, has been well established for the last 100 years.¹ The modern foundation of this scientific concept was

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¹ See generally FRANZ ALEXANDER, *PSYCHOSOMATIC MEDICINE* (2d ed. 1987); FLANDERS DUNBAR, *EMOTIONS AND BODILY CHANGES: A SURVEY OF LITERATURE ON PSYCHOSOMATIC INTERRELATIONSHIPS* (3d ed., 2d prtg. 1947); PIERRE JANET, *L' AUTOMATISME PSYCHOLOGIQUE*, (1889); 20 SIGMUND FREUD, *Inhibitions, Symptoms and Anxiety*, in *THE STANDARD EDITION OF THE COMPLETE PSYCHOLOGICAL WORKS OF SIGMUND FREUD* (James Strachey trans., 1959) (1925-1926); 2 SIGMUND FREUD,

established by the 'father of American physiology', Dr. Walter B. Cannon, Professor of Physiology at Harvard University.² Dr. Cannon described in the early 1950's, man's normal physiological state of 'homeostasis'.³ The term 'homeostasis' is widely accepted by the world scientific community and is found in Webster's Dictionary and the Encyclopedia Britannica.⁴ Homeostasis refers to a physiological state of normalcy wherein a person is in balance, i.e. equilibrium, with their internal and external environments.

Dr. Hans Selye described the state of disequilibrium in which homeostasis is threatened, and the body's attempt to respond to and survive a threat through "fright flight or fight" as the General Adaptation Syndrome (GAS).⁵ An everyday example of this phenomenon is "locker room jitters," where the affected individual experiences "butterflies" in the stomach, a general sense of being "on edge," sweating, a rapid pulse or heart beat, and often nausea, vomiting and diarrhea. Most individuals who have flown commercially have at some time experienced a "white knuckle" flight that has caused them anxiety, and often a sensation of flip-flops in their stomach. Some individuals who have experienced roller-coaster flights can fly again only with the aid of tranquilizers or a stiff drink.

It is reasonable to assume that an individual's homeostasis is threatened by a flight involving unusual altitudes and abnormally rapid descents. Selye explains that when there is a threat

Studies on Hysteria, in THE STANDARD EDITION OF THE COMPLETE PSYCHOLOGICAL WORKS OF SIGMUND FREUD (James Strachey trans., 1st ed. 1955) (1893-1895); DAVID V. SHEEHAN & THOMAS P. HACKETT, *Psychosomatic Disorders*, in HARVARD GUIDE TO MODERN PSYCHIATRY 319-356 (Arman M. Nicholi, Jr., ed. 1978); Joel Greenberg, *The Stress-Illness Link: Not If But How*, 112 SCIENCE NEWS 394-95, 398 (1977); ELLSWORTH K. GUNDERSON, & RICHARD H. RAHE, LIFE STRESS AND ILLNESS (1974); Z.J. Lipowski, *Psychosomatic Medicine in the Seventies: An Overview*, 134(3) AM. J. OF PSYCHIATRY, 233-44 (1977).

² See L.L. LANGLEY, HOMEOSTASIS 1 (1965).

³ See John R. Hubbard & Edward A. Workman, *On the Nature of Stress*, in HANDBOOK OF STRESS MEDICINE: AN ORGAN SYSTEM APPROACH 7 (1998); see also Marvin Huiwich & Amira Simha-Alperin, *Annihilation Anxiety in Psychosomatic Disorders in MIND-BODY PROBLEMS* 57-62 (J. Finell ed. 1997); see generally WALTER B. CANNON, BODILY CHANGES IN PAIN, HUNGER, FEAR AND RAGE (2nd ed., 1953); WALTER B. CANNON, THE WISDOM OF THE BODY (1963).

⁴ See RANDOM HOUSE DICTIONARY OF THE ENGLISH LANGUAGE 679 (unabridged ed. 1966); 6 THE NEW ENCYCLOPEDIA BRITANNICA 24 (15th ed. 1990).

⁵ See HANS SELYE, THE STRESS OF LIFE Preface xv, xvi, 12, 13, 29-40, 405-10 (Rev. ed. 1976); HANS SELYE, *Stress without Distress*, in STRESS AND SURVIVAL: THE EMOTIONAL REALITIES OF LIFE-THREATENING ILLNESS 11-14 (Charles A. Garfield, ed. 1979).

to an individual's well-being that results in GAS, the individual's Autonomic Nervous System (ANS) becomes hyperaroused.⁶ The ANS is the part of the body that is responsible for maintaining, along with certain hormones, survival functions, such as heart beat, respiration, temperature, and digestion.⁷ When survival is threatened the ANS kicks into high gear and gets the body ready for fight or flight.⁸

Another normal physiological "survival" response to abrupt unusual attitudes in flight is the *righting reflex*.⁹ This reflex serves the purpose of maintaining an upright posture, a stable platform, and does not involve higher brain centers.¹⁰ Many of us have experienced the *righting reflex* when dreaming of falling or tumbling in our sleep, suddenly waking and finding ourselves slapping or grabbing the bed surface, only to wake and realize we are safe. Similarly, when riding in a bus or subway car that abruptly lurches, it is our instinct to grab a pole or strap to maintain balance. The nervous pathways of this reflex are well known and described in the previously cited textbooks. The loss of equilibrium is instantly registered by sensors in the neck and body joints, change of the visual scene, and abrupt movements of the balance organ of the inner ear, known as the semi-circular canals, utricle and saccule. In the case of an airplane crash, the change in visual scene would involve the relative changes in sky, earth and clouds viewed through the cabin window as the airplane plummets to Earth. When equilibrium and a stable platform is not achieved, major stress is experienced and the hyperarousal noted above is accelerated.

Dr. B.A. van der Kolk explains that "[t]he intensity of the autonomic arousal in traumatized people causes them to go immediately from stimulus to response. . . . Autonomic arousal, no longer a preparation to meet external threat, becomes itself a precipitant of fear and emergency responses."¹¹ Dr. van der Kolk's observation, together with the rapidity of *life review* in

⁶ See *id.*

⁷ See *id.*

⁸ See *id.*

⁹ See J. Field, *Chapt XII: Vestibular Mechanisms Chapt. XLI: Posture and Locomotion*, in NEUROPHYSIOLOGY (1959); see also Joseph E. Hawkins, *The Physiological Basis of Mechanisms Governing Posture and Equilibrium*, in BEST & TAYLOR'S PHYSIOLOGICAL BASIS OF MEDICAL PRACTICE 91 8th ed. (1966); Albert F. Fuchs, *The Vestibular System*, in TEXTBOOK OF PHYSIOLOGY: EXCITABLE CELLS AND NEUROPHYSIOLOGY 582-84 (Harry D. Patton, et al eds., 21st ed. 1989).

¹⁰ See *id.*

¹¹ BESSEL A. VAN DER KOLK, PSYCHOLOGICAL TRAUMA 66 (1987).

near death experiences that will be described below, indicates why aircraft accident victims can experience the panorama of mental and physical phenomena in reaction to severe stress in a matter of several seconds.

In *Men Under Stress*, Roy R. Grinker and John P. Spiegel, writing of their World War II experiences as medical officers with the Air Force, described physical symptoms in acutely stressed aviators, including gastric distress, nausea, vomiting, diarrhea, urinary difficulties, loss of sphincter control (bowel), headache, abdominal pain and anorexia.¹² Dr. Douglas Drossman, states that "the observed association of stress with disease activation in Crohn's disease (regional ileitis) of the small intestine is explained by stress related alterations in psychoimmunological functions."¹³ Dr. Drossman further explains that the chemistry of the body that brings about the physical reaction to stress, targets the digestive system in the case of Crohn's Disease.¹⁴

Survivors of accidents and disasters have told of experiencing a *life review*, often related as "seeing their life pass in front of their eyes" while in the throes of an emergency situation. In a recent article published in the *Journal of Nervous and Mental Disease*, Ian Stevenson and Emily Williams Cook describe their evaluations of the memories of individuals experiencing severe physical illness or injury and found that complete life reviews had occurred in as little as three seconds.¹⁵ This strange phenomenon, where everything seems to slow down to crawl speed is known as *time distortion*.¹⁶ *Time distortion* is a common experience in individuals involved in auto accidents, however, Air Force flying personnel surviving aircraft mishaps have experienced this phenomenon as well.

When a passenger in an aircraft perceives a loss of stability related to unusual altitudes and G-forces of excessive roll, pitch and yaw, verified by a terrifying visual scene of a topsy-turvy world out the window, their normal state of homeostasis dissolves into dysequilibrium and terror. In *The Psychology of Death*,

¹² See ROY R. GRINKER & JOHN P. SPIEGEL, *MEN UNDER STRESS* 108, 109, 254-77 (1945).

¹³ See Douglas A. Drossman, *Gastrointestinal Illness and the Biopsychosocial Model*, 60(3) *Psychosomatic Medicine* 258-65 (May/June 1998).

¹⁴ See *id.*

¹⁵ See Ian Stevenson & Emily Williams Cook, *Involuntary Memories During Severe Physical Illness and Injury*, 1855(7) *J. NERVOUS AND MENTAL DISEASES* 452, 453-57 (1995).

¹⁶ See Douglas M. Carson, *Temporal Distortions*, *FLYING SAFETY*, March 1982, at 10.

a preeminent reference work in American thanatology, Robert Kastenbaum and Ruth Aisenberg state that the fear of extinction, annihilation, obliteration, "ceasing to be" is the basic fear of death.¹⁷ Hurwich and Simha-Alpern, writing in *Mind Body Problems*, describe similar observations in their paper, *Annihilation Anxiety in Psychosomatic Disorders*.¹⁸ Hendin in *Death As A Fact of Life*, states "some 5000 persons die daily in the United States. . . .some die of trauma. . . . what is important is that many die with a great deal of mental anguish."¹⁹ Hendin also quotes Dr. Russell Noyes, a psychiatrist at University of Iowa Hospitals: "the dying person fears the end to family relationships, the end of striving toward unrealized goals, the loss of friends and relatives."²⁰

Within a matter of seconds, a person caught in an aircraft mishap can experience a severe threat to their homeostasis concordant with mental anxiety at impending annihilation and quickly kick into the stress related response of GAS. The emotional tone and verbal content of voice recorder tapes recovered from the wreckage of fatal mishaps certainly confirm the anguish of those about to die. The author recalls the particularly chilling experience of listening to tapes recovered from fatal Air Force plane accidents. In one case, a cargo-transport aircraft flying a low level training mission accidentally struck a wire strung across a valley. The wire strike tore into a wing, rupturing fuel lines and wing control surfaces, starting a fire. Several aircrew members were on the intercom system during the mishap and their shouts, yells and screams were clearly heard as the aircraft inverted and eventually impacted the ground, killing all on board. Their verbalizations were a mixture of panic, regret, anger and anguish focused on the loved ones left behind and their unfinished personal business. Another accident involved a single seat fighter. The aircraft had lost a large piece of wing due to extreme G-forces resulting from the pull out from a dive. The pilot initiated his ejection system which failed, trapping him in the cockpit as the plane continued its dive to earth. The horrible last 15 seconds of his life were clearly recorded, reflecting his anger, helplessness, and great pain in being unable to escape certain death and having no opportunity to say goodbye to his

¹⁷ ROBERT KASTENBAUM & RUTH AISENBERG, *THE PSYCHOLOGY OF DEATH* 44 (1st ed. 1972).

¹⁸ Hurwich, *supra* note 3.

¹⁹ DAVID HENDIN, *DEATH AS A FACT OF LIFE* 99 (1973).

²⁰ *See id.*

loved ones. The tapes recovered from a fatal accident involving a jet transport revealed the panicked pilots unable to solve their mechanical problem and their last second utterances of “. . . .oh my God. . .we’re going to die. . .oh, no! Oh my God!. . .” Another recovered tape revealed the pilot saying “. . . .Dad. . .Dad. . .I meant to tell you. . . .”, indicative of unfinished business and unresolved family conflict survivors describe.

Interviews of aircraft accident survivors confirms the commonality of physical responses, such as sweating, palpitations, nausea, and loss of bladder and/or bowel control, as well as the shared anguish of an abrupt and unexpected farewell to loved ones.

There is another aspect of the victim’s experience, the individual’s actual destruction during the terminal phase of a fatal aircraft accident, that needs to be addressed. It is personally intolerable for family and friends to conceptualize the bodily destruction and pain experienced by a loved one. The phrase, “. . . .he (or she) never knew what hit them. . .” is a not uncommon attempt to soften the reality of that experience. Also, because it is not unusual for some passengers to “walk away” from an aircraft accident fatal to other passengers, there appears to be a continuum of death in the aircraft cabin, some passengers dying quickly, others slowly and some surviving. Unfortunately, crew and passengers may indeed “know what hit them.” In an aircraft accident involving extreme G-forces where aircraft occupants experience “multiple blunt force trauma,” and there are no survivors, one has to consider the sequential nature of bodily destruction which likely occurs in fractions of seconds. Whether death is due to invasion of the body from the outside by an object or the internal disintegration due to G-forces, there is an instant in time prior to death when the individual suffers that experience.

In conclusion, the scientific community through publication and practice support the concepts of homeostasis, the interrelationship of mind and body, studied through psychosomatic medicine, mental and physical reactions to stress that can be intense and rapid, and the fear of annihilation at impending death. Tapes recovered from fatal aircraft accidents, and interviews of survivors, confirm the terrifying physical and mental experience of the terminal minutes and seconds.