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Fetal implications of emotional stress

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THE FATAL IMPLICATIONS OF EMOTIONAL STRESS

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INTRODUCTION

For many years the importance of emotional influence on organic disease has been pointed out. It is widely accepted that emotional stress is frequently the precipitating factor in death resulting from underlying organic lesions. Death in such cases is generally attributed to an excessive, increased load placed on an inadequate, diseased cardio-vascular system. This is discussed thoroughly by Moritz (1), Hickam (2), Weiss (3), Chambers (4), Grollman (5), Bernreiter (6) and Gregg (7). Articles by Cleland (8), Moritz (9), Blanton (10) and Sheldon (11) dealing with causes of sudden death in man, however, seem to neglect the possibility that emotional stress may be the sole cause of death. Many such articles contain an "unknown" category but the implication seems to be that the organic causes of death were simply not discovered. Brouardel (12), in 1897, stated that cases in which death was attributed to hysteria were not conclusive and that it appeared to be organic lesions and not hysteria involved. At that time, he stated that Moliere was the only author who had published a case where it was impossible to discover any cause of death whatever, beyond hysteria.

The purpose of this paper is to review the more recent medical literature for possible instances of purely psychogenic death in apparently normal individuals and to review the possible

mechanism of death in such cases.

DEATH RESULTING FROM PROLONGED EMOTIONAL STRESS

"Voodoo" Death Phenomenon

Probably the most mysterious and fascination instances of death which appear to be purely psychogenic concern so-called "voodoo", "black magic" or "sorcery" deaths. The most recent case in this regard is the case of Australia's famous aboriginal artist, Albert Namatjira, who, although not dead, is reported to be slowly dying from a tribal curse at the present time. The Omaha World-Herald, Marchll, 1958, reports that native tribesmen "pointed the bone" at this man and, as is traditional in these cases, the victim slowly weakens and eventually dies.

Walter B. Cannon (13), in 1942, published an article entitled "Voodoo Death" in which he cites many instances of mysterious, sudden and apparently psychogenic death from all parts of the world. Cannon cites reports from as early as 1587 by Soares de Souza concerning instances of death induced by fright among South American Indians when condemned by a so-called "medicine-man". These tribesmen, lacking knowledge, accepted without question whatever was told them and the "medicine-man" by intimidation or by terrifying prediction apparently caused

death from fear. A report from Africa concerns a young Negro who unknowingly ate a wild hen which had been banned a taboo. He was told of this many years later, immediately became greatly possessed by fear, and within twenty-four hours he was dead. In New Zealand the "tapu" (taboo) is reported to be a very strong and terrible weapon. A Maoris woman ate fruit from a tabooed place and when told of this later proclaimed that she had profained the Chief and that his spirit would kill her. By noon the next day she was dead.

Cannon made a thorough search of such reports before he convinced himself of the authenticity of such deaths. He cited reports of physicians such as Dr. S. M. Lambert of the Western Pacific Health Service of the Rockefeller Foundation who witnessed several such cases in which the victim appeared very ill but had no physical signs of disease. Dr. P. S. Clark in North Queensland thoroughly examined a native who was "under a spell" and found nothing abnormal physically. This included a stool and urine examination. This native, however, gradually grew weaker and died. Postmortem examination revealed nothing to explain the cause of death. Similar reports are cited from Dr. W. E. Roth in Queensland and Dr. J. B. Cleland of the University of Adelaide. Cleland (14) mentions a robust tribesman in central Australia who was injured in the thigh by a spear which had been enchanted. The man slowly pined away and died without any

surgical complication which could be detected. Dr. Cleland believes that poisoning is entirely ruled out in such cases since there are very few poisonous plants available and he doubts that it has ever entered the mind of the Australian native that such might be used on human beings. Cleland cites other similar cases, some of which were autopsied with no organic cause of death apparent.

Richter (15), in describing the "voodoo" death phenomenon, quotes from the book "The Australian Aboriginal" by R. Herbert Basedow: "The man who discovers that he is being boned by an enemy is, indeed, a pitiable sight. He stands aghast with his eyes staring at the treacherous pointer, and with his hands lifted to ward off the lethal medium, which he imagines is pouring into his body. His cheeks blanch, and his eyes become glossy, and the expression of his face becomes horribly distorted. He attempts to shriek but usually the sound chokes in his throat, and all that one might see is froth at his mouth. His body begins to tremble and his muscles twitch involuntarily. He sways backward and falls to the ground, and after a short time appears to be in a swoon. He finally composes himself, goes to his hut and there frets to death."

Cannon notes that this phenomenon is characteristically found among aborigines who are so primitive and superstitious that they are "bewildered strangers in a hostile world". He

states that W. L. Warner, who has worked among aborigines in Northern Australia, believes such a phenomenon very hard to imagine in our society since it does depend on extreme social isolation of an ignorant, suggestible and superstitious individual. However, more recent reports indicate that a somewhat similar situation may actually occur in our society. Meerloo (16) states that from war experiences we have learned that the awareness of lack of inner defensive power and lack of forces to identify with means the greatest danger to us. He refers to persons placed in concentration camps by the Nazis who felt as though they had no human structure because the endangering powers were too overwhelming--there was no immediate feeling of fear, only of nothingness. This mental state seems to be somewhat similar to that of the ignorant aboriginals and might possibly also lead to death.

Mira (17), a psychiatrist in the Spanish War of 1939, cites cases of a "malignant type of anxiety" which he called "psychorrexis". This occurred among civilians during frequent bombing raids. These people showed anguish and perplexity to a greater degree than fear. They remained very quiet without any spontaneous activity, could scarcely concentrate, but were not very confused. Pulse, respiratory rate and tendon reflexes were increased but no focal symptoms were observed. At the end of three or four days the temperature rose very quickly and the

general state became worse. The tongue became ulcerated. the skin was slightly jaundiced and the abdomen tympanitic. The anguish remained but the patients became restless and exhibited an increasing number of automatic movements. Death in fatal cases occurred after three to four days. There was no delerium, spinal fluid was normal except for some increased pressure and no focal symptoms were observed terminally. In some, post-mortem examination showed swelling of the brain and even small hemorrhages--hence the term "psychorrexis". Mira attributes death in these cases to sudden, severe mental shock in individuals with a previous lability of the sympathetic system or with an exhausted physical state resulting from sleeplessness, fatigue etc. The combination of anxiety, rapid pulse and respiration associated with a shocking experience having persistent effects would fit well with fatal conditions reported from primitive tribes.

Cannon cites testimony of Wallace, a surgeon in World War I, concerning cases of shock in which neither trauma nor any of the known accentuating factors of shock could account for the disastrous condition. At times the wounds were so trivial that they could not reasonably be regarded as the cause of the shock state. Postmortem examinations on the fatal cases also revealed no gross injury. Moritz and Zamchek (18) report similar unaccountable deaths among soldiers in the Armed Forces during the

Second World War. These men also were apparently in good health prior to death and at autopsy no pathology could be found.

A somewhat different case referred to by Cannon concerns a woman of 43 who had undergone a complete hysterectomy. Although her emotional instability was recognized, she appeared to stand the operation well. Special precautions were taken to avoid loss of blood and she was given fluid intravenously following the operation. That night she was sweating, she refused to speak and her blood pressure fell to near shock levels. Her skin was cold and clammy and the measured blood flow through the vessels of her hand was very slight. There was no bleeding to account for her desperate condition which was diagnosed as shock brought on by fear. In this case, a calm and reassuring attitude on the part of the surgeon resulted in a change of attitude in the patient with recovery of a normal state.

That the attitude of the patient is of significant importance is becoming generally accepted. The well known surgeon, Dr. J. M. T. Finney (19) has testified on the basis of serious experience that if any person came to him for a major operation and expressed fear of the result, he would refuse to operate. Dr. C. Mallory (20) of the Massachusetts General Hospital also has expressed similar feelings.

Death from Self-Suggestion

Another type of death similar to the "voodoo" death phenomenon concens those rare cases in which a person predicts his own death or apparently dies from self-suggestion. This raises the question of whether a person actually can consciously will his own death. Von Lerchenthal (21), a Vienna psychiatrist, considered this question and concluded that this was indeed entirely possible. Although Von Lerchenthal was more concerned with the possibility of this type of death than with the reliability of case reports, he does present the following cases supporting this possibility.

—"Joseph Hayden is said to have written in his diary on the 25th of April, 1792, 'On the 26th of March at the concert of Mr. Bartholemon (London) there was an English Clergyman who while hearing my Andante sank into the deepest melancholy because of the fact that on the previous night he had dreamed of such an Andante which announced his death. He immediately left the company, went to bed and today I heard through Mr. Bartholemon that this Clergyman had died'."

—"Belgrade, Oct. 5, 1928 —In the village Koprivnica, a farmer named Ujoick said several months ago that he would die October 4th, 1928. On the appointed day he called his family, ordered his coffin, bade farewell to his friends and at noon, as he was seating himself at the table, he died of apoplexy. (Neues

Tagblatt, Oct. 6, 1928)"

Lercherthal concludes from such cases that it is a fact, "insofar as one can accept these reports as fact", that people determine to die and then do die at approximately the appointed time. Menninger (21), in editing Von Lerchenthal's article, refers to the writings of Dr. A. A. Brill of New York, Dr. Nolan Lewis of New York and Dr. Berhard Berliner of San Francisco in which similar cases are cited--many of which included autopsies with no serious somatic pathology found.

Simpson (22) mentions two cases in which death presumably resulted from the strong belief that death was imminent. In one case a nervous young man told his father "If they needle me again, I'll die". He was in a taut apprehensive state when the doctor came to remove chest fluid which had again accumulated and he died instantly the moment the needle reached the pleura. Autopsy revealed no organic cause of death. The second case concerned a Scottish janitor who was the victim of a mock execution by students. "He was led to the guillotine, jeered and cursed, blindfolded and forced down on the block. He was in terror and died the instant a wet towel was flicked in mock execution across the back of his neck." Von Lerchenthal cites an analogy to the latter case from Elick's book "Die Welt des Arztes" in which physicians carried out a similar experiment with a condemned criminal. He concludes that this proves beyond a doubt

the possibility of death by suggestion. Von Lerchenthal's belief is emphasized by his reference to a case in which a woman, with a long history of hysteria, predicted the date of her death. The woman, however, did not die at the appointed time. Von Lerchenthal states that the fact that she did not die was actually more remarkable than if she had as predicted! He concedes, however, that in many cases in which death was predicted by the victim, an underlying organic lesion was probably present initially. He theorizes that the prophesy may be the result of a subjectively felt organic disturbance and at the same time the cause of the heart stopping at a more or less definite time. "Externally, the person may appear in good health but, because he is not so, he talks of death." The fear of death or the idea of having to die may produce the additional load which causes cessation of the heart.

Psychological Consideration

According to Cannon (13) the psychological basis for the "voodoo" death phenomenon appears to be a complete withdrawal of society. The community withdraws all support leaving the victim isolated and alone completely. The only escape is death and consequently, in effect, the victim commits suicide. Cannon quotes from William James' "Principles of Psychology": "A man's social me is the recognition which he gets from his mates. We are not only gregarious animals, liking to be in

sight of our fellows, but we have an innate propensity to get ourselves noticed, and noticed favorably, by our kind. No more fiendish punishment could be devised, were such a thing physically possible, than that one should be turned loose in society and remain absolutely unnoticed by all the members thereof. If no one turned round when we entered, answered when we spoke, or minded what we did, but if every person we met 'cut us dead' and acted as if we were non-existing things, a kind of rage and impotent despair would ere long well up in us, from which the cruellest bodily tortures would be a relief.". Cannon states that the social environment as a support to morale is probably much more important and impressive among primitive people, because of their ignorance and insecurity in a haunted world, than among people living in civilized communities. Meerloo (16) agrees that the danger of separation and not belonging is experienced as tremendously traumatic. He states that the family, the group and the nation have acquired a protective function in human society as a "substitute womb" and that excommunication is like dying.

According to Rosenthal (23) psychologic defense mechanisms tend to break down when we are overwhelmed by anticipation of catastrophic developments. Normally, we move about without believing in our own death. We are intent on mastering death and maintain the conviction that we are exceptions whom death will

not strike. A person who finds himself in a crucial conflict and does not see any way out, may unconsciously regard death as the lesser evil and use it as an escape from the problem.

Von Lerchenthal (21) states that the desire for death may be so persistent that the goal is reached through nervous exhaustion. He feels that although the hysterical person as a rule does not usually go so far as to wish for death itself, the influence of the psychic emotional processes upon somatic organs may proceed further than the patient desires and finally may lead to death.

Physiological Consideration

Sympathico-Adrenal Theory-- After convincing himself of the reality of the "voodoo" death phenomenon, Cannon attempted to explain how such an ominous and persistent state of fear could end the life of man. To explain this, he turned to his experimental observations on rage and fear in cats. He believed that while rage is associated with the instinct to attack and fear with the instinct to flee, these two emotions have similar effects on the body (Cannon; 24). He further observed that when these emotions are aroused they bring into action the so-called sympathetic or sympathico-adrenal division of the nervous system which appeared to be under the control of the hypothalamic region of the brain (Cannon; 25, 26). As a rule the sympathetic division acts to maintain a relatively

constant state in the "internal environment" of the body. Cannon showed that in muscular effort this division acts by liberating sugar from the liver, accelerating the heart, contracting certain blood vessels, discharging adrenalin and dilating the bronchioles--all changes rendering the animal more efficient in physical struggle. Since these changes occur in association with strong emotions, they can be interpreted as preparatory for the struggle which the instincts to attack or escape may involve. Cannon maintains that if these powerful emotions are evoked and the bodily forces are fully mobilized for action, and if this state of extreme emotional stress continues in uncontrolled possession of the organism for any considerable period, without the occurrence of action, fatal results may follow.

Cannon noted that in the sham rage of the decorticate cat, there is an exhibition of intense emotional activity similar to that exhibited in man under great emotional stress. This activity lasts only three or four hours and then, without loss of blood or any other event to explain the result, the decorticate animal dies. It was also noted that when the signs of emotional excitement failed to appear, the decorticate animal might continue to live for long periods. Therefore, the death was attributed to a persistent, excessive activity of the sympathico-adrenal system. In support of this were further experiments

revealing that animals deprived of their sympathetic nerves and exhibiting sham rage continued to exist for many hours without signs of breakdown.

From his experiments, Cannon found that there was a gradual drop in blood pressure toward the end of the emotional excitement from the high levels of the early stages to the low level seen in fatal wound shock. Freeman (27) produced evidence that this fall in pressure was due to a reduction of the volume of circulating blood. When the blood volume is reduced until it becomes insufficient for the maintenance of an adequate circulation, deterioration accurs in the heart and also in the nerve centers which hold the blood vessels in moderate contraction (Cannon; 28). A vicious circle is then established with the low blood pressure damaging the very organs which are necessary for the maintenance of an adequate circulation. The gradual reduction of blood volume is explained by the action of the sympathico-adrenal system in causing persistent constriction of the small arterioles in certain parts of the body. In addition to the increased output of adrenalin, the constrictor effects of nerve impulses and the effects of circulating sympathin also maintain the constriction of the arterioles. In the peripheral structures and the abdominal viscera where the constriction of arterioles occurs, the capillaries become relatively anoxic and become more and more permeable to the plasma which escapes into

the perivascular spaces (Best and Taylor; 29).

Another factor contributing to the low blood volume is the prolonged lack of food and water. Freeman, Morison and Sawyer (30) found that a state of dehydration also excited the sympathico-adrenal system and thus another vicious circle may be started. The low blood volume of the dehydrated condition becomes intensified by further loss through capillaries which have been made increasingly permeable. Lack of food and water would collaborate with the damaging emotional effects to induce death. These are the conditions which are prevalent in persons who have been reported as dying as a consequence of sorcery. They go without food or water as they wait in fear for their impending death. Cannon concludes that in these circumstances they might well die from a true state of shock--a shock induced by prolonged and tense emotion which causes a continuous outpouring of adrenalin. In such a case, towards the end, the pulse would be rapid and thready; the skin would be cool and moist; the red blood cell count would be high and the hematocrit would reveal hemoconcentration; the blood pressure would be low; the blood sugar would be increased. The heart would beat faster and faster until a state of constant contraction were reached and until death occurred in systole.

Selye (31), in general, appears to support Cannon's concept of sympathico-adrenal discharge in emotional stress. He states

that there is no doubt that during emergencies both the medulla and the sympathetic nerve endings discharge excessive amounts of adrenergic principles and that these greatly influence the activity of the nervous system. Also, Selye states that a simultaneous diminution of vagal tonus presumably sensitizes the vascular system to effects of this adrenergic stimuli. That the sympathico-adrenal system is the primary system involved in this form of death is supported by the observations of Selye (32) that shock is not dependent on the pituitary-adrenal system. He has noted that after hypophysectomy, stress continues to cause an excessive output of adrenalin and shock may still develop. Also, he has shown that adrenal cortical extracts injected into adrenalectomized animals cause the thymico-lymphatic involution and the changes in blood count characteristic of the general adaptation syndrome but do not cause shock.

Selye apparently does not attempt to explain the actual cause of death in emotional stress. In discussing the general adaptation syndrome he states that the stress response consists simply of two parts: damage and defense. He admits that not much has been learned about the actual mechanism through which damage is produced and states (in 1952) that he could not explain how a distant stressor agent might produce shock or death.

Parasympathetic Theory-- Richter (15), of the Psychobiological Laboratory at Johns Hopkins Medical School, while performing experiments on rats, observed a sudden death phenomenon which appeared to be similar to that described by Cannon. Richter states that the phenomenon was discovered accidently first by Dr. Gordon Kennedy in 1953. Dr. Kennedy observed that when the whiskers were trimmed from the snout of a wild rat it began to behave in a peculiar manner, incessantly pushing its snout into the corners of the cage or into a food-cup with a corkscrew motion. Although before the clipping it had seemed entirely normal, eight hours afterwards it was dead.

Richter, in 1955, while conducting experiments on other lines, was reminded of the observation of Dr. Kennedy and it occurred to him to investigate the effect of trimming the rats whiskers on its performance in water. He had previously noted that rats swim in 95 degree water for 60 to 80 hours. Of twelve tame rats trimmed, one swam excitedly on the surface for a short time then dove to the bottom and began nosing its way along the wall. It died within two minutes after entering the tank without once coming to the surface. Two others died much the same way however the others swam for 40 to 60 hours. Then 34 wild rats were similarly tested. These animals are reported to be characteristically fierce, aggressive, and suspicious and are constantly on the alert for any avenue of escape when in

captivity. All 34 died within fifteen minutes after immersion in the jars.

From the results, Richter concluded that trimming the rats whiskers, destroying possibly their most important means of contact with the outside world, seemed disturbing enough to cause their deaths. The question arose concerning why the rats died so promptly under these circumstances. Under the influence of Cannon's conclusions, Richter looked for signs of sympathetic stimulation, especially for tachycardia and death in systole. EKG records were taken and contrary to expectation, the records indicated that the rats died with a slowing of the heart rate rather than with an acceleration. Terminally, slowing of respiration and lowering of body temperature were also observed. Ultimately, the heart stopped in diastole after a steady, gradual decrease in rate. Autopsy revealed a large heart distended with blood. The findings indicated that the rats died as the result of overstimulation of the parasympathetic rather than of the sympathico-adrenal system. Further tests supported this indication--pretreatment with atropine prevented this prompt death and tame rats injected with sublethal amounts of cholinergic drugs died within a few minutes after being placed in the jars.

Richter noted that the situation of these rats appeared to be one of hopelessness rather than one demanding fight or

flight. The rats were in a situation against which they had no defense and they seemed literally to "give up". It was observed that after elimination of the hopelessness by repeated short immersions the rats did not die. They learned that the situation was not actually hopeless and again became aggressive. Another observation by Richter was the remarkable speed of recovery when once freed from confinement. A rat that would have been dead in another minute or two became normally active and aggressive in only a few minutes. This seemed similar to the "voodoo" victims who recover promptly when the hex was removed.

That the wild rats seemed more susceptible to this type of death would suggest a higher vagal tone. In agreement with this thought are Richter's observations that vagus tone is higher in healthy, vigorous individuals than in weaker ones and that vagus tone is considered to be in general higher in wild than domesticated animals. This fact may also be important in explaining the primitive aboriginal susceptibility to the "voodoo" death phenomenon.

Richter concludes from his observations that apparently the "boned" victim, like the wild rat, is not set for fight or flight, but similarly seems resigned to his fate and dies as the result of hopelessness. This death is thought to be parasympathetic rather than sympathico-adrenal as Cannon

postulated. The previously mentioned references of Meerloo and Rosenthal would seem to support this view since they state that people under extreme stress may develop a feeling of "nothingness" and may unconsciously regard death as an escape from the situation without any feeling of fear or anger.

DEATH RESULTING FROM SUDDEN INTENSE EMOTIONAL STRESS

One frequently hears the remark "scared to death". The question arises whether this statement can be literally true--whether a severe emotional shock can produce sudden, almost instantaneous death in apparently healthy individuals.

Instances

In 1860, Laurence (33) reported of an apparently healthy housemaid who was surprised stealing food. This woman is said to have dropped dead on the spot. On postmortem examination there was found no congestion of organs nor any adequate cause for the death. Since that time there have been several similar cases cited in the literature but the validity of the reports has been generally questioned.

Meerloo (34), in 1950, stated that death may be the pure result of mental shock and refers to sudden deaths which occurred in a London air-raid shelter during the last war.

Apparently these people became petrified from fright and died of "anoxia in a state of rigor followed by a disastrous drop in blood pressure".

Robertson (35) also stated that a sudden, violent shock may cause instantaneous death in an individual and that post-mortem examination may afford little or no help as regards its mechanism. He maintains that even the idea of happiness and satisfaction may be so entrancing as to cause death. The case is cited of a woman who went to meet her husband who had been a prisoner for a long time. The woman "flung her arms round his neck and embraced him passionately, only the next moment to relax her hold and slip to the ground dead". Also, the case is cited of a young lady who had just been married. When the couple had retired to sign the marriage register she seemed exceedingly happy. She had just written her name, when she "fell down and died without a struggle".

Fear, dread and horror seem to be much more common causes of sudden death however. Robertson cites several cases of sudden death which apparently were the result of sudden fear:
--A woman, who, when wakened by an unusual noise outside her bedroom window, imagined that robbers were about to break into her room. She called out twice and fell back dead.
--A little boy, aged 12, was hungry and opened the door of a cupboard in which he knew there were some cakes. He opened the

door quickly in order to avoid being discovered. However, a black cat which had been shut up in the cupboard jumped down at the instant the boy was lifting the cake. He uttered a scream, rushed up stairs to his mother and fell dead at her feet.

—A youth dropped a living frog into the bosom of a lady dressed in a low-cut evening dress with the result that "she died almost at once from shock".

—A young woman, walking with her sweetheart along a country road, received such a fright when a horse pushed its white head through a hedge that she collapsed in her companion's arms and died.

—A hunter, knocked down by a panther but unhurt by it, received a profound nervous shock and died the following day.

—A nervous woman received news that a haystack belonging to her brother was on fire. She was "greatly overcome and died in a few minutes".

—A young woman, while brushing her teeth, accidently swallowed a mouthful of harmless mouth wash. She died from fright under the belief that it was poisonous.

It should be mentioned that Robertson, in citing these cases, gives no evidence of verification and therefore the validity may be questioned.

Cases similar to the last one cited above are referred to

by Richter (15). Richter states that according to Dr. R. S. Fisher, coroner of the City of Baltimore, a number of individuals die each year after taking small, sublethal doses of poison or after small, non-lethal wounds. They apparently die "as a result of the belief in their doom".

The instances of death cited by Simpson (22) concerning the mock execution and the needle incidents, might be placed in this category although these people were in a fearful state for some time prior to the specific emotional events from which they died.

Psychological Consideration

In explaining sudden death resulting from mental shock, Meerloo (34) and Milici (36) describe a reflex defensive reaction of lower animals in which they become suddenly rigid and try to resemble the surrounding physical world when danger approaches. Meerloo maintains that man possesses the same sort of primitive reflex reaction to danger as evidenced by the fact that man, in sudden fright, first stops motionless and petrified. Meerloo also considers shock a primitive defensive mechanism by which a physiological decortication of the brain takes place. This places the animal in a kind of natural narcosis with the organism acting as a hibernating animal requiring less energy from outside and with internal stabilization becoming

greater. Meerloo describes shock as a disintegration and disruption of appropriate functions by way of transition to a more effective defense.

Meerloo further contends, however, that those reactions which are effective and suitable in lower and less differentiated animals are no longer suitable for man. Man, being an anticipating animal, may be mobilized before he is threatened. These defense mechanisms are therefore often overdone and fright reactions may become paralyzing reactions and may even cause death.

Physiological Consideration

Examination of these deaths which occur almost instantaneously makes it clear that no sufficient time elapses for the development of any material organic change--even a biochemical change like anoxia or alkalosis. Simpson (22) states that some functional lapse alone could afford an explanation; the most acceptable being some cause for sudden, complete inhibition of the heart's action since this alone causes literally instant death.

Brouardel (12), of Paris, apparently first used the phrase "death due to inhibition" in 1867. Since that time, according to Kayssi (37), the phrase has been used much too frequently to cover ignorance of the real cause of death.

Kayssi states that the term "inhibition" was used first in 1846 by the Weber Brothers after discovery that excitation along the course of the vagus and irritation along its peripheral end after section led to slowing of the heart and even stoppage in diastole. It was also noted that Rosenthol, in 1861, inhibited respiration by exciting the vagus centrally. Kayssi states further that the inhibiting action of the vagus may also occur by reflex action. This reflex is accomplished through centers existing in the central nervous system after being initiated in certain important areas of the body such as laryngeal, epigastric, testicular, cervical and cardiac when subjected to trauma or irritation. In this regard, Simpson (22) reviews the mechanism of the regulation of circulatory volume and pressure which has been established since Bayliss first envisaged a vaso-vagal tonal control in 1923 and Heymans and Bouckaert demonstrated the aortic and carotid bodies in 1939. Overstimulation of the vagal trunk leads to slowing of the heart, contraction of the coronary vessels, and dilatation of the splanchnic vessels. A positive depression of the heart rate ensues, the rhythm being interrupted sometimes permanently with the result that death follows instantly. Simpson also states that stimuli which excite such responses may develop naturally from the aortic or carotid bodies. Any rise in arterial pressure sets this reflex in motion bringing quick

action through the afferent depressor fibres of the vagus. Simpson concludes that fatal vagal inhibition is likely only if the emotional tension is high and that the heightened response lies plainly under the control of the sensory cortex and the thalamus--the latter possibly initiating emotional conditioning.

Kayssi maintains that there must be a "personal sort of constitutional susceptibility" for the occurrence of fatal inhibition by the vagus with highly emotional individuals being considered more liable. He states that although excessive emotion following disturbing news or incidents has been advanced as a cause of death from inhibition, he personally has found no such cases in the literature worth serious consideration. If such cases have occurred, he believes that death was probably due to pre-existing heart disease with emotion provoking a sudden hypertension.

Weiss (17) agrees that instantaneous death is usually cardiac in origin and that its occurrence depends on an underlying physiologic mechanism. However, he also states that the sensitizing factors in inhibition death may be merely transient emotional excitement. Under the influence of stress and strain, according to Weiss, a remarkable degree of hyperactivity of selected reflexes can develop. He maintains that, in the normal person, the tonus and activity of the reflexes of the autonomic

nervous system vary considerably and therefore, although the effect of emotion on the heart may be slight in some people, in a few cases such stimulation may precipitate an alarming seizure or death.

This inhibition reflex may also possibly explain another mysterious form of sudden death called "Bangungut" (meaning to rise and to groan) which has been reported by Nolasco (38) and Majoska (39). This peculiar phenomenon apparently occurs only in Filipino men and has been reported in the Phillipines and in Hawaii. These men retire in apparently good health and then die sometime during the night. Among many theories, the deaths have been attributed by some to nightmares since gasping and moaning frequently precedes death. One case is cited in which the groaning victim, when awakened with difficulty by a roommate, complained of being choked to death by a "little man". In another case, the victim awoke and complained of nightmares. However, he subsequently went back to sleep and died. It was noted that in a large number of these cases the victims retired on a full stomach. The distended stomach has been suggested as the factor initiating cardiac inhibition reflexly through the vagus or by direct pressure on the heart. The possibility that the deaths are purely psychogenic, however, has not been ruled out. It appears probable that Filipino men may have the "constitutional susceptibility" mentioned by Kayssi.

It might also be well to mention, for completeness, the so-called "exhaustion deaths" seen in acutely disturbed mental patients (Shulack; 40, 41) (Madow and Stauffer; 42). Although we are not primarily concerned with these cases since the individuals involved are not apparently healthy, normal people, the deaths do appear to be psychogenic in origin. The deaths occur suddenly and at autopsy no adequate organic cause for the deaths has been found. These patients typically go through a period of sustained motor and mental excitement from two days to two weeks in duration. There is a thready pulse, loss of weight, profuse clammy perspiration, a fall in blood pressure and hyperpyrexia ending in a sudden cessation of respiration and heart beat. Theories regarding death in these cases appear to be dominated by the vagal inhibition theory. The vagal inhibition is thought to be associated with a predisposing labile autonomic system. Thompsen (43), however, feels that the symptoms suggest a "hypothalamic syndrome" rather than a hypersensitive vagus. In such a case, death would be the result of excessive stimulation of the hypothalamus with activation of the sympathico-adrenal system as described by Cannon.

SUMMARY

Although it is widely accepted that emotional stress is frequently the precipitating factor in death resulting from an underlying organic disease, the possibility that death may result solely from emotional stress appears to have been somewhat neglected. Recent medical literature has been reviewed for possible instances of psychogenic death and for possible mechanisms of such death.

Several references were found concerning deaths in which no cause could be determined other than mental stress. These deaths seemed to fall into two broad categories: death which occurred almost instantaneously following a severe emotional shock and death which occurred after a more prolonged period of mental stress.

Of the latter group, perhaps the most interesting concern death resulting from sorcery or "voodoo". These deaths have been reported from all parts of the world and are found characteristically among primitive, superstitious and suggestible aboriginal people. These people are easily intimidated by their "medicine-man" and greatly fear their spirits and respect their taboos. When a native breaks a taboo or is placed under a "spell" he gradually grows weaker and finally dies with no evidence of organic disease before or after death. Such deaths have been witnessed and described by

qualified physicians and therefore the reports appear to be quite reliable.

The possible mechanisms of death in such cases have been considered. Psychologically, it has been suggested that an important aspect is the complete withdrawal of society from the condemned man leaving him completely isolated. Several writers have agreed that this isolation and the lack of belonging may become very unbearable and the victim may unconsciously seek death as an escape from the situation.

Two theories concerning the actual physiological mechanism have been presented. One concerns persistent emotional stimulation of the sympathico-adrenal system which leads to an excessive outpouring of adrenalin with resultant vaso-constriction, decreased blood volume and eventually a shock-like state and death. The other concerns excessive stimulation of the parasympathetic system with resultant decrease in heart rate to the point of complete stoppage of the heart in diastole. Naturally, proving the theories in a human would be quite difficult since such cases are very rare and occur in remote places. Both explanations are based on animal experiments (decorticate cats for the first and rats for the latter) and therefore intrapolation can not be definitely conclusive. It is possible that the response in the individual may vary depending on the particular emotion

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involved. Stimulation of the parasympathetic division seems to be associated with a feeling of hopelessness while stimulation of the sympathico-adrenal division seems associated with fear and rage.

It has been suggested that deaths such as these could not occur in our society because of the lack of superstition and lack of suggestiveness. However, it has been shown that in periods of persistent stress, in war particularly, there have been many deaths for which no organic cause could be found. These deaths have been attributed to emotional stress and probably are basically similar to the "voodoo" deaths with the extreme feelings of fear, hopelessness and isolation. The importance of the emotional state in life or death is becoming generally accepted in our society. It has been noted that more surgeons now hesitate to perform operations if the patient expresses undue fear of the result. The possibility has been suggested that a person might actually be capable of consciously willing his own death. Cases have been reported in which individuals have predicted the exact date of their deaths. Also, it has been shown that a person, who imagines that he is surely to die from some lethal medium, may actually do so although the medium be harmless. Many reports of such occurrences appear to be quite reliable and valid.

Several cases have been cited concerning death which occurred almost instantaneously following a severe emotional

shock. Most of these cases, however, have not been validated conclusively and some writers doubt that emotional stress is the only factor involved. In explaining this sort of death, it has been suggested that man possesses the same sort of primitive immobilization reflex which is seen in lower animals. Also, it has been proposed that shock likewise is actually a primitive defensive mechanism designed to place the animal in a kind of natural narcosis for protective purposes. It is suggested that, since man is an anticipating animal, he may be mobilized prior to the time he is threatened. Therefore, the primitive defense mechanisms may be overdone and a fright reaction may become a paralyzing reaction and even cause death. The actual mechanism of the instantaneous death appears to be a reflex vagal inhibition of the heart. It is thought that a heightened emotional state or an inherently labile autonomic nervous system is a prerequisite for such inhibition to occur. The sudden death phenomenon of "Bangungut" and the "exhaustive" deaths seen in acutely disturbed mental patients have been mentioned in this connection since it is thought by some that the reflex vagal inhibition may be involved in these cases also.

CONCLUSIONS

1. Death as the result of pure emotional stress is possible and does occur.

2. Psychogenic deaths result from persistent, strong emotional stimulation of the autonomic nervous system— either the sympathico-adrenal or the parasympathetic division with more investigation necessary to definitely determine which.

3. Instantaneous death resulting solely from a sudden, severe emotional shock has not been conclusively validated. However, it appears probable that this may occur in a person with a "constitutional susceptibility" by means of a reflex vagal inhibition of the heart.

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