

Human Adjustment to an Exotic Environment

The Nuclear Submarine

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MAN has, in the current century, been making tremendous technicological advances, and these advances have permitted him to explore new or "exotic" environments. Examples of these explorations are the year-around colonization of the Antarctic, the adventures into outer space, and the developing exploration of and attempts to inhabit the inner space, the oceanic subsurface. The inherent stresses man encounters in attempting habitation of the polar ice caps or outer space are items of common knowledge; the stresses encountered in man's effort to explore, inhabit, and use the "inner" space are not, however, well documented. Efforts made toward understanding and using the submarine space have been primarily military ones. This restrictiveness may be one reason for the scarcity of published material dealing with the adjustment patterns of the men who make these efforts.

My intention here is to provide observational data on one aspect of the submarine environment: the adjustment of men to prolonged submergence aboard a nuclear-propelled polaris-missile-firing submarine. These observations were made while I was serving as the medical officer aboard two polaris submarines. Discussions with fellow subma-

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rine medical officers led me to believe that adjustment patterns reported herein are not isolated occurrences but are perhaps common to many polaris submarine crews. It is recognized, however, that human adjustment is a complex function and is affected by many variables. It is not my intention to claim that the adjustment pattern described in this paper applies to all submarine crews.

The submarine is not a device which came into being in this century, as might commonly be thought. Leonardo da Vinci designed a submarine but never tried to build it. The first operational submarine was apparently designed and built in 1624. It was a wood and leather vessel which was rowed at a depth of from 12 to 15 ft in the Thames River. One hundred fifty-two years later the American colonial navy used the *Turtle*, a one-man submarine, against a British vessel in New York harbor. The Confederate navy built a series of submarines; the Confederate submarine, *Hundley*, was the first submarine to destroy an enemy ship. On Feb 17 1864, the *Hundley* sank the *USS Housatonic*, but also sank itself as well. The use of submarines in World Wars I and II is well known.

Prior to 1954, the submergence capability of a submarine was determined primarily by mechanical factors and the submarine's atmospheric dependence and not by human factors. The launching of the *USS Nautilus*, SSN571, in 1954 changed the determining factors. Nuclear power truly freed, for the first time, the submarine from its atmospheric dependence. The submarine became capable of prolonged submergence periods, and man's capacities for adjustment and endurance became the new limiting factors. The US Navy, in apparent recognition of man as the limiting factor, has elected to man each polaris submarine with two complete crews. These crews alternate between being on the submarine for about 90 days and receiving refresher training at a US Navy base. This method of manning the polaris submarine has apparently been adopted to obtain the maximum submerged patrol time on a continuing basis.

The Submariner

The submariner considers himself to be essentially different from his Navy-wide

peers. He is, first of all, a volunteer for hazardous duty. He is young, healthy, and considers himself to be intellectually brighter and more educated than a nonsubmarine-going peer. Some of the sailor's verbalized motivations for submarine service frequently given are (1) extra pay, (2) good food, and (3) opportunities to learn interesting skills.¹ He has had to pass a number of screening tests which examine his intellectual level, emotional stability, and physical status. The evolution of these tests has been described elsewhere by Weybrew.² After the intensive screening, the submarine candidate receives additional training in his specialty area and a formal school period in the US Navy Submarine School. One screening device which has not been reported elsewhere is a crucial one and is used after the sailor's graduation from school and after he reports to his first submarine assignment. This device is the "Qualification in Submarines" procedure. The new submariner is required to demonstrate his theoretical and practical knowledge of the submarine to a group of senior shipmates. Should he be considered deficient in either area he may be dropped from the submarine program. Although the qualification phase does not explicitly examine the candidate's ability to make a satisfactory interpersonal adjustment, such ability is of great importance to his shipmates and is "unconsciously" evaluated and acted on by them. The crew is able to quickly isolate and reject any new member who is unable to make a satisfactory interpersonal adjustment. Finally, the submariner is characterized by a much higher level of career motivation and reenlistment rate than are found in the navy at large.

The Submarine Environment and Its Stresses

The group of about 140 men making a polaris submarine patrol live in an encapsulated world. Moreover, they live in that environment for about 60 days at a time and during that period are relatively isolated from the external world. Since the submarine operates more or less independently of the surface, some loss of circadian and geographical orientation occurs. The only practical circadian clues routinely available to

the submariner are the type of food being served at meal time and the length of time until the evening movie. Whereas the sailor may well know the date he may well *not* know the day. The environment consists of continual and relatively nonvarying auditory, olfactory, and thermal sensations which soon assume a "white background" characteristic. These inputs become important only when they suddenly alter and the submariner begins his reflexive quest for "what's wrong."

The submarine's environment is a densely populated one. Personal territory is highly limited and is, in effect, defined as one's bunk, the only space that the submariner is not forced to share with others. It has been estimated that the individual submariner has 5 cubic yards of private space,² the space occupied by a 6-ft-tall man standing on an area of 57 sq in. The crew's mess hall and the officer's wardroom are used as social areas and eating areas but also as lecture halls, movie theaters, and even as surgical suites. All other spaces are primarily work spaces.

The degree of the submariner's isolation is shown by the fact that he is unable to communicate with the external world. To keep the secrecy of its position inviolate, the submarine is enjoined from initiating radio transmissions. Normally the submarine will communicate with the outside world only when it experiences a major emergency. The submarine is, however, in continual receipt of radio messages. Some of the material received is general news which may be passed on to the crew. In addition to the general news material, the individual submariner is allowed to receive a 15-word message from his family on each of three times during the patrol. Although the contents of these messages is bland, the failure to receive a "family gram" at the expected time is a stressful situation for the submariner.

The submariner is well aware of the fantastic destructive power present in the nuclear missiles on board. He is also aware that these missiles are to be fired only in retaliation to a nuclear attack on the United States. The implications of these weapons and the significance of an actual launching situation is relatively clear to all personnel on board. It is a rare occasion when the

missiles and their nuclear armament are discussed in any way other than a highly technical fashion. This very avoidance reflects the stressfulness of their presences.

Finally, there are two other areas of stress which are not necessarily an inherent part of the submariner's environment but which are frequently seen to be operative. The first of these areas is involved with the submariner's professional life and the rewards for his expended efforts. The polaris submariner is repeatedly told that he is working to prevent war, primarily a nuclear war; the submariner has some difficulty integrating this goal with his knowledge of the ongoing world conditions. In addition, the submariner is unlikely to perceive much inherent reward in his job. Most of the personnel on board are involved in either the constant monitoring of machinery operation or the preventive maintenance of machinery. The crewman may receive little praise at all if his machinery functions well but may receive instant criticism when a piece of the machinery fails. The second area of stress is centered in the external world and is crystallized in the submariner's concern about the general welfare of the family and the conduct of his wife. Whereas the submariner may continue to feel a major obligation for the welfare of his family unit, he also recognizes that while on patrol he is impotent in assisting the family. He may become overly concerned about his family's welfare—as if he must create the image of a family problem which is as ominous as his impotence to deal with the problem. Some of these fears, including the conduct of his wife, may be well founded or they may be unrealistic and may approach a delusional intensity.

General Adjustment Pattern

The polaris submariner's time on the submarine is clearly divided into two unequal parts. The first part is about a 28-day period and the second part is about 60 days in duration. Each period has its characteristic stresses.

Upkeep.—First is the "upkeep" period for the polaris submarine, which lasts about four weeks. The submarine will have just returned from a patrol, and the upkeep period begins with the new crew coming aboard. During this period consumable stores and spare parts must

be replenished, any external hull work accomplished, the repair or replacement of malfunctioning machinery effected, and any possible land-based social activity enjoyed. This four-week period also embraces much time spent in the crew's refamiliarization with the submarine and the testing of the submarine and the crew by operational trials at sea. It is a period characterized by marked physical and emotional demands on the submariner to accomplish the work, to control his anger generated over frustration in attempting to get the submarine ready for sea, and to enjoy the traditional sailor's pleasures ashore. The initial portion of the "upkeep" period appears to be characterized by a slight elevation of the group mood as compared with that of the period immediately preceding the upkeep. However, this mood soon begins to turn downward, and before the termination of the four-week period the crew's prevailing mood is one of mild depression characterized primarily by irritability, restlessness, and a mild depressive affect.

Submergence.—The polaris deterrent patrol starts when the submarine leaves its tender and cruises on the surface to its diving area. The initial submerged period appears to be one of relief for the sailor. He experiences relief from the physical and emotional demands of upkeep. He is setting up the patrol routine which he will follow for the next eight weeks. His routine day is becoming established and is probably not yet interrupted by the drills, lectures, and other "all hands" evolutions which will later disturb his off-duty hours or his sleep. There is a general rebounding of the mood from the mild depression which existed at the end of upkeep to a mild or moderate elation during the first several days of submergence. The sailor explains this change by the aphorism, "Sailors belong on ships and ships belong at sea." The group mood soon, however, changes again, and a depressive trend becomes apparent.

The first definable period of adjustment to submergence may be called the "one-quarter-way syndrome" and is usually well established by the second week of submergence. A marked increase in sick call visits occurs. The submariner's complaints are usually subjective ones. Headaches, nuchal and occipital in location, constipation, and "chest and head colds" comprise the bulk of the complaints. Many statements are made concerning feelings of anxious expectancy. Crew members begin to develop disturbances of their sleep patterns. These deviations encompass both poles, insomnia and hypersomnia. The crew displays some tendency to adolescent gang behavior. The submarine

crew represents a well-organized and formal group structure, with the crew comprising a missile-men gang, sonarmen gang, navigation gang, etc. Each of these naturally occurring subgroups is formed of peers having a specific technical skill. There develops between these gangs a feeling of "friendly competition"; the competition may center about attempts to kidnap the totem of another gang—the missile gang's plastic bird, for example. While observing this behavior one is reminded of gang behavior of early pubescent boys. This is also a period when sexual humor is very evident—usually in conjunction with the recounting of personal exploits ashore. This adjustment pattern continues to develop and then fades into the next phase.

The next definable period is at the end of four weeks—the "half-way syndrome." This period represents the low point in the group's mood. A feeling of depression, of varying intensity, appears to be experienced by all the crew during this phase. Many complaints are verbalized and many of these have a familiar depressive quality. Changes in appetite, bowel function, complaints of headache and muscle ache, difficulty in concentration, and sleep disturbance occur in a major portion of the crew. Also, various crew members verbalize another common depressive position, pessimism: because the past has been unpleasant and unrewarding the future will be the same. The submariner looks back on four weeks of routine, of boredom, and of increasing depression, and he looks ahead to four weeks more of the same feeling. The individual man shows much introspection and intrapersonal withdrawal. He becomes primarily concerned with himself and the welfare of his family. His social contact with his fellow crew members is primarily maintained by involvement in structured situations—card games, watch standing, and meals. Another striking change that occurs during this phase of adjustment is the appearance of intensely sarcastic humor in place of the previous sexual humor. This change in humor style appears to serve two functions. One is the discharge of hostile and aggressive affect which is personally and culturally unacceptable and which might otherwise be physically acted out. The second is the keeping of the other shipmates at a comfortable distance, resulting in the temporary expansion of an individual's personal territory. Occasionally, during this period, a few individuals begin to complain about the loss of normal circadian clues and may eventually report brief derealization or depersonalization-like episodes.

The transition from the half-way syndrome

to the next describable point, "three-quarter-way syndrome," is not as smooth as the other transitions. The half-way syndrome is terminated and the transition to the three-quarter-way syndrome is marked by a sudden, but short-lived, elevation of the group's mood. There then sets in a progressive remission of the depressive mood. By the end of about six weeks of submergence, there is once again affectual lability; interpersonal approach no longer requires a structured program and the bulk of the depressive somatic equivalents have been relinquished. The type of humor has once again changed, with sexual material again becoming predominant. Along with the sexual humor there is an increasing tendency to physical contact. This, rather than homosexual acting out, seems to serve the function of preparation for anticipated heterosexual activity.

The transition from the three-quarter-way syndrome to the final-week syndrome is rather rapid. The majority of the crew continues to show a lifting from the depressive mood. However, for the first time during the submerged period, a definite split in the affective tone of the crew can be seen. While the majority of the crew shows a continuation in the remission of depression, some crew members show a sudden reversal and exacerbation of the depressive syndrome. These last-week depressives may be classified into two subgroups. One group readily verbalizes a fear of returning home to resume the masculine role, both sexual and social, in the family. They seem to view their on-board position as much less threatening than their position at home. This group, as one might guess, shows a predominance of the passive-dependent character. The other subgroup is composed of highly motivated, career-oriented, and compulsive individuals who started the patrol with definite goals to be achieved. While his goals may not have been excessive in view of a 60-day submergence period, the individual's effectiveness in working to achieve the goals was unfavorably affected by the general depressive experience. The sailor fails to achieve his self-imposed goal by the end of the patrol. These individuals, unlike the first subgroup, do not desire to remain at sea indefinitely but only long enough to "finish the project." In addition, their degree of untoward response to the approaching termination of the patrol is not as marked as that of the former group.

The final-week syndrome is terminated in the last several days before surfacing by the development of what the sailor would call "channel fever." A feeling develops which is somewhat comparable to a hypomanic state in that the sailor has a general sense of well being,

a feeling of being capable of an excessive amount of work, and a feeling of diminished need for sleep. This state persists until the submarine "ties up" alongside its tender, and then the hypomanic state tends to rapidly revert into a mild depressive one, with the principle somatic equivalent being a feeling of fatigue. This final depressive position is normally resolved only after some time is spent away from the submarine.

Comment

The polaris submariner lives in a monotonous and crowded environment. His personal safety and the accomplishment of the submarine's mission depend on the successful blending of diverse personalities into a smoothly functioning team. The major operative stresses in the environment which interfere with the team formation are the lack of objective reward for expended efforts, the inability to communicate with persons in the outside world, the lack of sufficient personal territory, the nonvariability of physical environmental stimuli, the concern for the conduct and welfare of the family, and, finally, the presence of nuclear weapons on board.

The mental mechanisms used to deal with the operative stresses are essentially those that Grinker considers to be a normal part of the psychic structure of young adult males.³ They are denial, as frequently seen in the control of anger or the dealing with the interpersonal conflicts; sublimation, as readily seen in the employment of humor as a means of dealing with sexual impulses or aggressive feelings; and isolation affect, as may be seen in the apparent inability to discuss the submarine's nuclear armament in any other than a technical and bland manner. The defense mechanisms, however, do not appear to be sufficiently strong to assist all individuals in maintaining normal adjustment status. Instead, individual defense mechanisms may become more pronounced in the submariner's adjustment to the submergence. Should the individual, for example, tend to externalize his intrapersonal problems he may be expected to develop some degree of paranoid ideation during the submerged period. The degree of decompensation is, of course, determined by a complex of variables, but the range of the more pathological decompensations is from a

transient situational reaction to a gross psychotic disorder.

In effect the sailor on a polaris submarine patrol is the same individual he is when ashore, ie, he has the same ego balance of strength and of weakness. The chronic stresses of the patrol test the equilibrium of the submariner's ego balance. The outcome of the testing is most likely the same whether the test occurs while the sailor is on patrol or ashore.

As described above, the common mode of adjustment to the exotic environment of the polaris submarine appears to be a depressive one. The crux of the various forces leading to this depressive position would appear to be the anger experienced by the various members of the crew. The anger is an outgrowth of the frustrations experienced by the submariner in dealing with his environment. However, there appears to be no personally or culturally acceptable means of discharging this anger. The paternalistic organization of the military system is one which does not permit the direct expression of anger and aggression toward the military system. In addition, there is the personal fear that the overt expression of anger may lead to a socially isolated position within an already isolated community. The individual has little opportunity to handle his hostile affect by sublimation, except through humor. The submariner is then forced to deal with his anger by denial, suppression, or turning against himself. The hostile affect becomes internalized, but it ultimately manifests itself as a depressive phenomenon.

The terminal group depressive response is of interest in that its genesis is most likely different from the one I have used to explain the patrol depression. The terminal depression appears to be explained most readily by the psychiatric concept of separation anxiety. The termination of patrol represents, to the submariner, an object loss—both real and symbolic. At the "real" level the termination of patrol means the dissolution of the crew group. A marked decrease in social contact will occur among the various crew members during the three months ashore. Some crew members will either be transferred or be leaving the navy at the end of each patrol, clearly showing the interpersonal loss. The symbolic loss is, perhaps, more

significant than the real loss. This intrapersonal loss involves the surrender of a dependent position. The sailor has been living in an emotionally stressful environment but an environment which also regularly, reliably, and abundantly met his physical needs—with the singular exception of sex. The sailor has not had to employ even the normal terrestrial maneuvers needed to obtain food, shelter, clothing, etc. By necessity, all has been provided for him.

It is not uncommon, during the submerged patrol, to hear the submariner make joking references to "returning to the womb," and he is capable of recognizing the omnipresent justification for his remark. Thus the termination of his time on the submarine requires that the submariner surrender this passive mode of existence. The surrender of the passive, dependent role is not necessarily an easy thing, for the submarine or for others, and is accompanied by the depression which is frequently seen when people are forced to renounce their infantile strivings.

Observations which tend to support the above formulation have been reported by A. Blackburn in a personal communication to me. He has "wintered out" in a small Antarctic station occupied by equal numbers of military personnel and civilians. The military personnel showed an adaptation strikingly similar to the one described in this communication. The civilians, on the other hand, appeared relatively free from the depressive phenomena. The civilians freely expressed their anger. The military personnel were apparently either unable or unwilling to express their anger openly. Gunderson⁴ and Mullin⁵ also report very similar adjustment patterns in their writings on adjustment to Antarctic living. Gunderson's study was unable to show any significance between the group's size and its adjustment. His study, which was apparently based on a written questionnaire, also showed that symptoms of dysadjustment were most prevalent at the midwinter point, as were the submariner's at the midpatrol point. The subjective complaints given by the men were sleep problems, irritability, loneliness, headaches, and depression—essentially the complaints of the submariner. Gunderson does not, however, speculate on the genesis of

this adaptational syndrome. Mullin has stated rather clearly what he and I consider to be one of the main problems in human adjustment to an isolated environment. He stated, "We were impressed by the relative absence of overtly expressed hostility" and "Group and individual tensions and irritations are ever present, but the most important lesson a wintering-over man learns is that he cannot afford to alienate the group; that in this tight little society he is dependent in large measure upon the goodwill of the next man and of the group as a whole for his vital feelings of security, worth and acceptance." Mullin also suggested, as this communication does, one motivation to volunteer for duty in an isolated and uni-sexual environment: "On the other hand, for a few men it was obvious that separation from home, wife, children, and family responsibility meant for them the subtraction of an element of stress in *their* personal adjustment."

It would seem that with the prospect of space travel and inhabitation of some portion of space so closely at hand, at least as represented by the manned orbital laboratory, that studies to determine the adjustment of groups to isolated environments are imperative. The polaris submarine represents an environment in which many important

studies could be carried out. The situation is one which would lend itself to careful and long-term study and one which should be productive of significant results.

The polaris submarine offers a unique opportunity to observe and study the adjustment pattern of men as they cyclically move between the "normal" terrestrial life adjustment and the "exotic" submarine life adjustment. It should be a fertile ground for investigations in group dynamics and adjustment.

Summary

The polaris submariner is a highly screened individual placed into a chronically stressful and frustrating environment. When the individual begins to develop feelings of anger in response to the frustrations, he is faced by a cultural structure which does not readily permit the expression of anger. He is then forced to turn the anger inward and then experiences a depressive phenomenon in reaction to operative stresses. The course of this depressive phenomenon is believed to be a ubiquitous phenomenon among the polaris submarine crews. A similar adjustment pattern has been reported from other isolated environments. It is believed that the polaris submarine represents an ideal laboratory in which to study the dynamics of group adjustment to unusual environments.

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