An extensive blood testing program for all military dogs in Vietnam was conducted in 1969. From mid-January to mid-March an attempt was made to collect biweekly samples from all dogs which, based on an initial screening, had total white blood cell counts less than 7,500/mm^3 and/or packed cell volumes less than thirty-seven percent. These blood specimens were used extensively in initial studies of the disease (98). Later in the year, a screening program was established to obtain monthly blood samples from all sentry, scout, and tracker dogs. This program was designed to detect tropical canine pancytopenia suspects (3).

During 1970 tropical canine pancytopenia continued to be the most significant health problem in military working dogs in Vietnam, but a less severe one than previously; it was not considered an emergency condition. The 936th Medical Detachment reported that 104 dogs were hospitalized for this disease in 1970, and that this represented twenty-four percent of the total number of dogs hospitalized by this unit. This was a lower percentage of total admissions than in 1969 (4). The Staff Veterinarian, United States Army, Pacific stated in September 1970 that, "Tropical Canine Pancytopenia (TCP) in Military [sic] dogs is not currently a problem (76)." Whether a problem or not, the incidence of tropical canine pancytopenia did decrease in 1970, and it is interesting to speculate why.

In late 1969 and early 1970 a standard therapeutic regimen of fourteen days administration of tetracycline was begun. The establishment of this regimen was based on clinical impressions gained in Vietnam and on a paper published in 1969 by S.A. Ewing (37) which

suggested that the tetracycline group of antibiotics might be useful in treating canine ehrlichiosis. The regimen involved the intravenous administration of 250 mg tetracycline twice daily for two days followed by the oral administration of 1,500 mg tetracycline for twelve days (144). Although highly speculative, this regimen may have accounted for the dimunition in the number of cases in 1970. The blood testing and tick control programs continued in 1970; they probably also contributed to the improved situation in 1970, but both of these programs were conducted throughout 1969 with little apparent effect. The annual report of the 936th Medical Detachment suggested that the tetracycline regimen was effective (4).

In 1971 and 1972 tropical canine pancytopenia occurred primarily as a chronic disease in Vietnam which led to debility and lost duty time, but few acute hemorrhagic deaths. The United States Army, Vietnam Staff Veterinarian, who departed Vietnam in May 1972, said that, "Possible explanations for the decline in the severity of the disease may be the widespread use of tetracycline, the early death of the most susceptible dogs, the lack of introduction of new susceptible dogs from the states, or an attenuation of the causative agent (34)." This Staff Veterinarian also pointed out that when he arrived in Vietnam in March 1971 there were 900 military dogs on duty; when he departed in May 1972 there were 150. The reduction in the number of military dogs in Vietnam was probably a major factor in reducing the visibility of the tropical canine pancytopenia problem. Some statistics will illustrate the extent of the tropical canine pancytopenia problem in 1971 and 1972.

In 1971 the incidence of tropical canine pancytopenia was seven per month per 1000 dogs with fifty-one lost duty days per month per 1000 dogs. Seven dogs died of the disease, and an additional twenty-six dogs were euthanatized because of poor duty performance resulting from the disease (90). In the first half of 1972 the incidence dropped to four per month per 1000 dogs with forty-eight lost duty days per month per 1000 dogs. Two dogs died, and one dog was euthanatized (91). Clearly, tropical canine pancytopenia had become a less severe problem, but the accuracy of these numbers must be evaluated in light of the dramatic decrease in the number of military working dogs in Vietnam.

The exact number of dogs which died of tropical canine pancytopenia is impossible to ascertain. Different veterinarians used slightly different diagnostic parameters to establish a diagnosis; dogs were stationed all over Vietnam, and in the course of business were shipped into and out of Vietnam, as well as to different locations within Vietnam; and last, but probably most important, the exigencies of war took precedence over the niceties of clinical medicine and research. None of these factors contributed to accurate bookkeeping. Reasonably accurate estimates indicate that between 200 (60) and 250 (58) dogs died during the epizootic. Some reports indicate that more than 300 dogs died (88,141). A precise death toll is of no great consequence, but it is important to recognize that tropical canine pancytopenia did much more than kill dogs. It caused a great deal of morbidity with the resulting loss of dogs which could not perform their duties. It caused a constant drain on veterinary

resources from mid-1968 until the end of the war; during some periods it completely dominated the veterinary service. It similarly preoccupied many of the veterinarians at the Walter Reed Army Institute of Research. The direct dollar cost of this disease, although unknown, was certainly considerable. Military working dogs cost several thousand dollars to purchase and train; their death or incapacity was expensive. The manpower and materiel costs were also high. People and things were constantly travelling, meetings were held, research projects were started, and pharmaceuticals and other medical supplies were consumed. The epizootic of tropical canine pancytopenia cost much more than the lives of 200 or 300 military working dogs.

Description of the Disease

History

A. Donatien and F. Lestoquard (30) first reported canine ehrlichiosis in Algeria in 1935. They referred to the disease as canine rickettsiosis and to the organism as Rickettsia canis. Ewing (37) compiled an excellent history of the disease. He reviewed cases in Southern Rhodesis (71), South Africa (97), East Africa (14,22), Lebanon (110), the French Congo (83), Uganda (15), the Belgian Congo (47), French West Africa (92), India (93), Sudan (48), and Chad (115) between 1937 and 1949. He also reported that canine ehrlichiosis continued to be a problem in Africa (17) and the Indian subcontinent (84,114) during the 1950's and early 1960's. A case of

canine ehrlichiosis was reported in Israel in 1972 (69). These early reports of the disease often referred to concomitant infection with Babesia canis (37).

Canine ehrlichiosis was first reported in the Americas in the Netherlands Antilles in 1957 (10), and the first case in the United States was reported in Oklahoma in 1963 (36). The disease was later reported from Texas in 1971 (109), Arkansas in 1971 (39), and Illinois in 1975 (131). The dog afflicted in Illinois had, however, lived the previous two years in India.

Canine ehrlichiosis, as mentioned previously, was noted in British military dogs in Singapore in the 1960's (133,151) and was named tropical canine pancytopenia because of its uncertain etiology. The 1968 outbreak of the disease in military working dogs in Vietnam was reported in several papers (61,62,63,98,146); this outbreak provided the impetus for detailed investigation of the disease and its causative agent. The work precipitated by the epizootic in Vietnam is still continuing, and has produced most of the detailed information known today about canine ehrlichiosis. The following is a review of that information, and is largely based upon a review of the disease by D.L. Huxsoll (59) in 1976.

Clinical Signs

Clinical canine ehrlichiosis manifests itself in acute and chronic forms. D.L. Huxsoll (59) reported that, "Following inoculation with infective blood, signs of acute disease appear within 7-10 days and consist of fever, serous nasal and ocular discharges, anorexia, depression, loss of weight, elevation of the erythrocyte

sedimentation rate and pancytopenia." These signs may be mild and go entirely unrecognized. In fact, recent evidence, which will be discussed in more detail later, suggests that most canine ehrlichiosis infections are mild enough to go unrecognized (78). Most dogs survive the acute phase, and then enter a chronic phase during which the dog appears normal, but infection with the ehrlichia organism persists. Many dogs experience no further disease; this condition has been referred to as mild chronic tropical canine pancytopenia (12). Dogs with the mild chronic form of the disease may be unthrifty and lethargic workers (78). Other dogs, particularly German Shepherds, develop a severe chronic (12) form of the disease typical of the epizootic which occurred in Vietnam. D.L. Huxsoll (59) described this severe chronic form as follows:

> Most dogs which develope severe chronic TCP are presented with clinical signs of hemorrhage. In many instances, a sudden onset of epistaxis is the first indication that a dog is affected as the initial acute phase has gone unnoticed. Accompanying signs include anemia; edema of limbs and scrotum; loss of weight; petechial and ecchymotic hemorrhages on the abdomen, the mucosa of the penis, the buccal cavity and conjunctiva; anorexia; dyspnea; fever; corneal opacity; lethargy; lymphadenopathy; posterior weakness; melena; and hyphema. Hematological examinations reveal a severe pancytopenia. Many of these dogs succumb as a result of hemorrhage and/or secondary infection.

Clinical Pathology

A profound balanced leucopenia (leucopenia with normal differential white blood cell count) with decreased packed cell volume, red blood cell count, and hemoglobin value is typical of clinical canine ehrlichiosis (146). Thrombocytopenia is also

present (63). Coagulation time and prothrombin time are normal, but bleeding time is prolonged (63). The erythrocyte sedimentation rate is usually elevated (121), and bilirubin values are normal (146). Blood chemistry values including alkaline phosphatase and serum glutamic oxaloacetic transaminase are usually normal although blood urea nitrogen values are significantly higher in chronic cases; total serum protein concentrations decrease in terminally ill dogs (146).

Gross and Microscopic Pathology

Hemorrhage, both gross and microscopic, is the predominant pathologic sign of tropical canine pancytopenia. Hemorrhages occur in the subcutaneous tissues, central nervous system, eyes, heart, lungs, lymph nodes, tonsils, gastrointestinal tract, kidneys, urinary bladder, and testicles. Central lobular degeneration and/or necrosis in the liver and bone marrow hypoplasia are nearly constant findings. The spleen is usually slightly enlarged, and mild hemosiderosis is often found in both the spleen and liver. Perivascular accumulations of lymphoreticular cells and plasma cells are seen in many tissues, particularly in the meninges, kidneys, and lymphopoietic tissues. This reticuloendothelial response resembles the microscopic pathology of other immunoproliferative diseases (57).

Epidemiology

Canine ehrlichiosis outbreaks have often been associated with heavy tick infestation (37,98,146,151). This clinical observation was confirmed in 1975 when M.G. Groves et. al. (51) reported that Rhipicephalus sanguineus, the brown dog tick, was capable of transmitting the agent to normal dogs. This study demonstrated

transstadial but not transovarial transmission. A later study (130) used light, fluorescent, and electron microscopic studies to demonstrate Ehrlichia canis in the midgut, hemocytes, and salivary glands of Rhipicephalus sanguineus ticks.

Since transovarial transmission of Ehrlichia canis apparently does not occur, the tick is not a likely reservoir of the disease. Chronically infected dogs as well as wild canines such as foxes, coyotes, and jackals may be reservoirs of the disease (59); this is supported by a study which reported successful transmission of the disease from experimentally infected foxes to dogs by the tick Rhipicephalus sanguineus (1).

The disease is more common in tropical areas, and a high-to-low incidence gradient appears to exist between southern and northern latitudes in the northern hemisphere (78). This gradient would presumably be reversed in the southern hemisphere, and is likely the result of increased tick populations in warmer climates. Nevertheless, infections probably can occur anywhere the vector can live (59).

Reports of canine ehrlichiosis suggest that certain breeds, particularly the German Shepherd, are more susceptible to the disease, especially the severe hemorrhagic form of the disease (59). This conclusion must be embraced cautiously since the Vietnam epizootic in military German Shepherds represents an overwhelming majority of the clinical cases ever observed.

There is no evidence to suggest transmission by contact (59).

The Causative Agent

Ehrlichia canis is a small, pleomorphic organism found in circulating leucocytes of the dog. It is a member of the tribe Ehrlichiaeae, family Rickettsiales. Other members of the genus *Ehrlichia* include *Ehrlichia bovis*, *Ehrlichia ovina*, *Ehrlichia phagocytophilia*, and *Ehrlichia kurlovi*. *Ehrlichia canis* inclusions are found in the cytoplasm of circulating leucocytes, and in the cytoplasm of mononuclear cells in impression smears prepared from lung, spleen, and kidney tissues (59). Ultrastructural studies have shown that these inclusions consist of elementary bodies bound by two trilamellar membranes and contained within membrane-lined vacuoles (56,127,128).

The study of *Ehrlichia canis* was initially hampered by an inability to cultivate the organism in any system except the live dog. Efforts to cultivate the organism in other laboratory species, embryonating eggs, and conventional cell cultures were unsuccessful (62,63,76). M.B.A. Nyindo et al. (100) developed a system for propagating *Ehrlichia canis* in monocytes harvested from the blood of dogs acutely infected with the organism. This technique improved the ability to study the organism dramatically, but still required the sequential transfer of organisms from infected to uninfected dogs, thus still requiring the use of live dogs. Infected monocytes could only be harvested from dogs in the acute phase of the disease, and the monocyte yield was limited by the amount of blood which could be safely removed from the dog.

E.H. Stephenson and J.V. Osterman (134) later developed a technique for obtaining peritoneal macrophages by repeated peritoneal lavage in dogs which had previously received the intraperitoneal administration of sterile mineral oil. These macrophages were then infected with Ehrlichia canis. This technique greatly increased the yield of mononuclear cells which could be used for study, but still required the use of live dogs.

I.E. Hemelt et al. (55) reported the serial propagation of Ehrlichia canis in canine peripheral blood monocytes. This permitted the serial passage of Ehrlichia organisms without the continual need for the laboratory dog.

There has been little effort to determine how much variability there is among various Ehrlichia canis isolates. A mildly pathogenic strain was isolated from a dog in Arkansas which produced inclusions in circulating neutrophils and eosinophils rather than lymphocytes and monocytes (39), and a later report suggested that this neutrophilic strain of Ehrlichia canis may be identical to Ehrlichia equi, the causative agent of equine ehrlichiosis (80). More likely, the different manifestations of the disease result from breed differences among dogs, not strain differences among Ehrlichia organisms (59).

Immunology

D.L. Huxsoll's review of canine ehrlichiosis (59) refers to reports of hypergammaglobulinemia (12,13,151), plasmacytosis (57,140), and persistent infections (12,38,60,121) in dogs afflicted with ehrlichiosis. These observations, coupled with others that demonstrate that antibody titers to Ehrlichia organisms rise for

months after infection (12,150), suggest that there may be an immunologic basis for tropical canine pancytopenia. D.L. Huxsoll's review also stated that W.C. Buhles, Jr. et al. (12), "Concluded that the continued increase in antibody titer and the development of hypergammaglobulinemia and plasmacytosis probably reflect persistence of the antigen and may represent a mechanism analogous to the excessive production of immunoglobulins in Aleutian disease of mink, lymphocytic choriomeningitis, African swine fever, and equine infectious anemia." P.K. Hildebrandt et al. (57) noted similar lesions in these diseases and tropical canine pancytopenia. The exact role of immunopathology in these diseases remains ill-defined, but it is interesting to observe that in early 1969, prior to the post-epizootic flurry of research, a viral infection with an autoimmune response similar to Aleutian Disease in mink was suggested as the cause of idiopathic hemorrhagic syndrome (75).

Other studies suggest that immunology has a role in the pathogenesis of tropical canine pancytopenia. R.D. Smith et al. (129) reported that an increased platelet destruction, similar to that which occurs in immunologically-mediated idiopathic thrombocytopenic purpura in man, results in the thrombocytopenia seen in tropical canine pancytopenia. I. Kakoma et al. (65) reported that lymphocytes from Ehrlichia canis infected dogs were cytotoxic for autologous monocytes, and that this monocytotoxicity was temporally related to the thrombocytopenia. This study also demonstrated T-lymphocyte activation and an apparent change in self-non-self recognition by monocytes and lymphocytes in infected dogs; these results suggest an

autoimmune phenomenon. G.E. Lewis, Jr. et al. (79) reported that anti-Ehrlichia canis antibodies apparently must react with, or opsonize, Ehrlichia canis prior to its entry into immune macrophages if these macrophages are to destroy the organism with maximum efficiency. G.E. Lewis, Jr. and M. Ristic (81) reported that maximum immunity to canine ehrlichiosis probably requires the interaction of both humoral and cellular immune components in proper sequence, i.e., probably requires both immune mononuclear phagocytic cells and Ehrlichia canis-immune serum.

I. Kakoma et al. (66) demonstrated that dogs with sera positive for anti-Ehrlichia canis humoral antibodies also inhibited platelet migration; this suggested that the pathogenesis of canine ehrlichiosis involved an immunologically-based damage to platelets.

Diagnosis

A diagnosis of ehrlichiosis is based on clinical signs, pathologic findings, serology, and organism identification. Clinical signs and pathology have previously been discussed.

Direct and indirect serologic tests are available for canine ehrlichiosis. A test by direct immunofluorescence for identifying Ehrlichia canis in buffy coat tissue smears was reported in 1971 (16). An indirect fluorescent antibody test was developed in 1972 (119); this test has been employed in the mass serologic screening of military working dogs (78).

Ehrlichia canis inclusions or morulae can be demonstrated in the cytoplasm of mononuclear cells in blood smears, and morulae can be found in impression smears of lung. A Romanovsky stain is used, and

the diagnostician should be prepared for a lengthy search, particularly in chronically ill dogs.

Treatment and Prevention

Tetracycline can be used in both treating and preventing canine ehrlichiosis. Dogs can generally be cleared of infection when treated orally with tetracycline at a dosage rate of thirty mg per pound per day in divided doses for fourteen days (2,12). Canine ehrlichiosis can be effectively prevented by the use of lower doses of tetracycline; an oral dosage of three mg per pound per day will prevent the disease (2,23).

Tick control measures are essential as are those designed to prevent the inadvertent injection of infective blood and tissue into uninfected dogs. The careful screening of blood donors is particularly important.

Chapter IV

OPERATIONAL EFFECTS OF THE DISEASE

The epizootic of canine ehrlichiosis in Vietnam adversely affected military operations. That much is made clear by a simple study of the epizootic itself. Unfortunately, it is difficult to piece together the operational details related to the disease; it is difficult to establish which units were adversely affected, and when, and how. This seems to result from a dichotomy of interest between the veterinary and the operational personnel involved in this epizootic.

A careful reading of the operational record from Vietnam reveals virtually nothing about canine ehrlichiosis. Unit histories, inspection reports, concept analysis team reports, the "operational report--lessons learned" series, and other reports written during the epizootic all say essentially the same thing: nothing. This is despite the fact that these reports frequently mention military working dogs. Why do these reports fail to mention the disease even during periods when these same units were asking for help in alleviating critical dog shortages? The answer apparently lies in the divided responsibility for care and use of the dogs: the operational or unit personnel were responible for the day-to-day care of the dogs and for the operational employment of the dogs; the veterinary personnel were responsible for the medical care of the dogs. Consequently, when the operational reports were filed, they failed to mention what seemed to belong only in the veterinarian's

bailiwick--canine ehrlichiosis. The veterinarians, on the other hand, did the very same thing in reverse. They apparently had little interest in the operational effects of the disease; their interest appeared to be limited almost exclusively to medicine.

A very careful reading of the sizable volume of veterinary literature about canine ehrlichiosis reveals virtually nothing about the impact of the disease on military operations. The veterinarians, when confronted with this disease problem, immediately launched into a detailed medical and scientific discussion of the disease. They did not record the operational effects of the disease because military operations were someone else's responsbility.

These comments are not intended to inpugn the motives of either the operational or the veterinary personnel; both groups did their respective jobs well. Nevertheless, it is unfortunate that the operational personnel seldom mentioned the disease, and the veterinary personnel seldom mentioned military operations. This complicates gaining a complete understanding of the canine ehrlichiosis epizootic in Vietnam.

Having described the dichotomy of effort between operational and veterinary personnel, the exceptions to the rule should be noted, particularly the cases where operational personnel actually did mention the disease in their reports.

The 18th Military Police Brigade reported that on 6 June 1970, 215 or fifty-one percent of its 418 sentry dogs were infected with tropical canine pancytopenia (132). The brigade also reported that the disease was complicating the retraining of dogs and handlers

because disease suspects could not be returned to the United States Army Pacific Sentry Dog School in Okinawa.

The Army Concept Team in Vietnam reported that in September and October 1969 idiopathic hemorrhagic syndrome was a problem in Vietnam with thirty-six percent of the Army sentry dogs in Vietnam classified as suspects (41). The Concept Team also reported that in late 1970 and early 1971 tropical canine pancytopenia was the "worst health problem" among mine detection dogs used in vehicle convoy operations in Vietnam (43).

Finally, the 8th Military Police Group reported that from May to October 1971 tropical canine pancytopenia was a health problem among marijuana detection dogs, and implied that the disease contributed to the dogs' inability to work for prolonged periods and their need for frequent rest periods (103). So there are some direct reports of the operational impact of canine ehrlichiosis.

Despite the paucity of reports of operational ineffectiveness directly attributed to canine ehrlichiosis, it is possible to indirectly reconstruct some of the effects of the disease. These effects include the direct loss of dogs, the costs involved in dealing with the epizootic, the strain the disease placed on limited veterinary resources, and several others. The death of a large number of military working dogs is perhaps the most obvious effect of the disease.

Canine ehrlichiosis killed 200-300 dogs in Vietnam during the course of the war. The death of this many dogs obviously had an adverse effect on military operations which required dogs.

The 212th Military Police Company (Sentry Dog) experienced thirty-seven deaths from tropical canine pancytopenia or 18.5 percent of an average population of approximately 200 dogs between August 1968 and December 1969. During this same period, the infantry scout dog platoons experienced 116 deaths from an average population of about 600 dogs (98). This many deaths clearly produced adverse effects on military operations.

The morbidity which resulted from tropical canine pancytopenia is perhaps even more important than the deaths. Units frequently had more than half their dogs classified as suspects (132,142), and many units were unable to perform their missions, particularly in 1969. This led to the establishment of two dog-holding detachments at the two veterinary hospitals in 1969. Dogs were transferred to these holding detachments and, if their hospital stay was expected to exceed fifteen days, the dog unit was permitted to requisition a replacement dog (3,96,102). The establishment of these holding detachments is in itself strong evidence that tropical canine pancytopenia was indeed a serious problem.

The morbidity and mortality both contributed to significant manpower losses in dog units. It must be recognized that when a dog is disabled, the dog's handler is also effectively disabled. If a dog dies, the dog handler must be retrained with a new dog. This is a lengthy process, which, as mentioned, was itself complicated by the epizootic. Efforts to control the disease also consumed manpower. Tick control, nursing care of sick dogs, and the periodic drawing of blood specimens from all dogs consumed a significant amount of time which could have been spent prosecuting the war.

Although the cost of the tropical canine pancytopenia epizootic is impossible to determine precisely, it surely ranged into the millions of dollars. The value of a trained military dog in 1969 was somewhere between $5,000 and $10,000; one source referred to a $6,000 price tag (95). Using a conservative $5,000 value per dog and a conservative 200 deaths, the direct cost in dogs alone was $1,000,000. To this must be added transportation, laboratory, medical care, and the very significant veterinary research costs. The Walter Reed Army Institute of Research devoted much time to this disease from late 1969 until the end of the United States involvement in the war. These efforts cost large amounts of money, and, although not directly related to the war in Vietnam, the research efforts have continued until the present day. Serologic screening of military working dogs has been periodically conducted since the end of the war, a serologic survey of all military working was conducted in 1980, and a follow-up survey is being conducted in 1981 (78). Canine ehrlichiosis has been an expensive disease.

The resources of the Army Veterinary Service in Vietnam were strained by this disease, especially in 1969. A shortage of enlisted animal specialists required the use of enlisted food inspectors to help perform the animal care mission (96). Simultaneously, the veterinary service was called upon to deal with: the clinical cases of the disease, both the early febrile and later acute disease; the dramatically increased number of involved necropsy procedures; and the geometric increase in the number of blood samples which had to be drawn. Added to these demands was the need to first establish the 936th Medical Detachment hospital as a quarantine station, and then

later to establish dog holding detachments at both the 936th and the 764th Medical Detachments. The need to establish the quarantine station and the dog holding detachments inevitably led to less efficient, though not lower quality, veterinary care; this lack of efficiency naturally increased the effective workload.

One example should serve to illustrate the tremendous workload generated in Vietnam by canine ehrlichiosis. In March 1970, the veterinary service drew blood samples from 1,148 of the 1,227 military working dogs in Vietnam (143). The dogs were located at about fifty different locations throughout Vietnam. The blood had to be drawn, transported to the 9th Medical Laboratory, and the laboratory had to perform the hematologic analysis. Each dog's medical record had to be properly annotated, a record had to be maintained for each individual sample, and, after the results were obtained, many dogs required treatment for the disease. This represented only one month's workload for blood testing alone. This blood testing was carried out monthly, and, in early 1969, suspect dogs were tested biweekly (146). This provides some measure of the workload created by the disease.

During 1969 a problem developed in evacuating dogs from dog units and veterinary clinics to the two veterinary hospitals where comprehensive veterinary care was provided. Dogs were often held too long in the veterinary clinics near the dog units rather than evacuate them to the hospitals. A firm seven day evacuation policy was established to remedy this problem, and a veterinary medical regulator was designated. This evacuation policy involved the Air Force as well as all medical units which used ground and air ambulance services (3,96,102). The evacuation policy successfully solved

the problem, but the need for such a policy was, of course, dictated by the large number of patients which required hospitalization; this, in turn, was dictated in large part by the number of dogs requiring hospitalization for tropical canine pancytopenia.

The epizootic also created some altogether new work requirements for the veterinary service. There was deep concern that the movement of both military and pet dogs from Vietnam to the United States and other countries might result in the spread of what was then a very mysterious, dreadful disease. Strict requirements for the issuance of health certificates were established which required a blood test for each dog leaving Vietnam. A normal total white blood cell count and packed cell volume were required before a health certificate could be issued. This was not a foolproof system for preventing the spread of the disease because dogs incubating the disease would not be detected (102), but this additional testing responsibility was borne by the veterinary service.

The possibility of a public relation's nightmare for the Army influenced operational decisions throughout this epizootic. It is impossible to quantify the influence of this potential nightmare, and certainly a retrospective look at the decisions made inspire confidence in the decision-making process, but the public relation's aspects of this epizootic were constantly kept in mind.

Early in the epizootic, when the disease was a complete mystery, there was a perceptible fear that the United States Army had introduced a previously unknown dread disease directly into Vietnam and perhaps indirectly into Okinawa via the British-trained tracker dogs from Malaysia.

The disease also created some interesting public relation's problems as the need for military dogs declined during the Vietnamization period. Dogs, like men, became excess to military requirements during this period. The return of men to the United States easily reduced the number of men, but the solution was not so simple for dogs, principally because of tropical canine pancytopenia. If excess dogs were shipped to the United States, and the epizootic were shipped with them, woe be to the veterinarian who authorized the shipment. He would be summarily hanged by the American Kennel Club and the editor of Dog World. On the other hand, what could be done with hundreds of excess military dogs? Destroying large numbers of dogs was impossible because of humanitarian and public relation's reasons. The Army's popularity, which had already reached new lows, would be severely damaged by the image of wholesale dog destruction. Colonel Robert M. Nims, a research veterinarian at the Walter Reed Army Institute of Research, was quoted in an Army Times article in June 1970: "The disease [canine ehrlichiosis] is causing serious problems with the dog program in Vietnam, but Colonel Nims denied earlier reports in the press that 1000 dogs were going to be put to sleep because they were infected. 'This is only done in extreme cases and usually when the animal is incapacitated or suffers too much (120).'" Colonel Nims was obviously concerned that the public would conjure up visions of the wholesale slaughter of 1,000 dogs. This would disturb any veterinarian because the various humane groups are probably even more formidable than the American Kennel Club, and

certainly more formidable than the editor of Dog World. No wholesale slaughter ever took place, of course; some dogs were shipped out of Vietnam after careful blood testing; others were given to the Armed Forces of the Republic of Vietnam as part of the Vietnamization program; and others were humanely euthanatized because of chronic illness. But the concern for the welfare of these dogs was very real and continued until the end of United States involvement in the war (34)[d].

In summary, canine ehrlichiosis clearly had an operational impact on the Vietnam War. It was by no means the margin of victory or defeat, but the operational readiness of military working dog units was reduced by the disease. To the extent that military working dogs influenced the war, canine ehrlichiosis influenced the war. The disease killed and disabled many dogs; it cost a lot of money; and it strained the ability of the military veterinary service to perform its mission. It was by far the single most significant canine disease which presented itself during the war, and it dominated the animal care efforts of the veterinary service for long periods of time. Although difficult to measure precisely, the impact of this disease was very significant.

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[d]This discussion is not intended to suggest that Army personnel, Army veterinarians in particular, were so crass and callous that they made their decisions about tropical canine pancytopenia and the fate of these dogs with one eye constantly on the newspaper. That simply was not so. The decisions about tropical canine pancytopenia were based on military requirements tempered with a reasonable dose of humanitarianism. Public relations, nevertheless, was a real factor in making these decisions, so it cannot be completely ignored.

Chapter V

IMPLICATIONS FOR THE FUTURE USE OF MILITARY WORKING DOGS

The implications of the canine ehrlichiosis epizootic in Vietnam can be grouped into two broad categories. First, there are implications for the prevention, control, and treatment of canine ehrlichiosis itself. Second, and probably more important, there are the more general implications for the health care of military working dogs; these implications are not tied to canine ehrlichiosis per se, but they suggest changes in the way military dogs are cared for and employed.

The direct implications of canine ehrlichiosis are reasonably straightforward. They include: screening prospective military dogs for the disease and rejecting or treating infected dogs; periodic serologic examination and treatment as required of dogs on active duty; rigorous tick control; evaluation of the geographic areas in which military dogs are employed to determine the disease threat; education of veterinary officers, veterinary technicians, and animal handlers about the canine ehrlichiosis problem; and further research.

The military services are probably regularly buying canine ehrlichiosis in new canine recruits. A recent serologic survey demonstrated that over fifty percent of all Department of Defense installations throughout the world which employ military working dogs have dogs that are infected with ehrlichia organisms (78). This survey, which tested all Department of Defense dogs using the indirect

fluorescent antibody test, reported that eleven percent of Army dogs and thirteen percent of Air Force dogs were infected, and that eight percent of all military working dogs were infected with ehrlichia organisms before entry into military service. These dogs generally performed well, although some are probably lethargic and slightly anemic; nevertheless, because clinical canine ehrlichiosis is a stress-related disease, they represent a biological timebomb waiting to explode if these dogs are exposed to the stress of combat conditions. Prospective military dogs should be screened using the indirect fluorescent antibody test, and rejected if infected. Alternately, successful treatment could permit acceptance of infected dogs.

Military working dogs should be serologically examined for ehrlichia organisms at least annually; infected dogs should be treated with tetracycline and then carefully monitored serologically. In endemic areas, a continuous regimen of oral tetracycline (three mg per pound per day) should be used for all dogs. This will eliminate the organism from most dogs, and continued serologic monitoring will detect any recurrences. Isolated cases in non-endemic areas, or animals with clinical disease, can be treated with a high dose regimen (thirty mg per pound per day in divided doses for fourteen days).

Serum samples can be obtained easily during the periodic physical examinations already required for military dogs. A useful secondary effect of a serologic testing program is the development of "serum banks" which can be used to evaluate the incidence of "new" dog diseases as they occur. For example, the "bank" of serum at the

Walter Reed Army Institute of Research developed because of the ehrlichiosis problem was later useful in evaluating a canine parvovirus vaccine and outbreaks of an epizootic diarrhea among military working dogs at Fort Benning and Lackland Air Force Base (78).

The need for rigorous tick control is apparent. Canine ehrlichiosis is a tickborne disease and therefore highly susceptible to tick control measures. Tick control is difficult, and 100 percent control is often impossible, particularly in tropical and semi-tropical climates, but weed control measures around kennels, construction of kennels to reduce tick infestation, strict kennel hygiene, insecticide use in kennels and on dogs, and the physical removal of ticks from dogs by dog handlers can all significantly reduce tick populations.

Information about the possible threat of ehrlichiosis should be gathered before dogs are introduced into a new geographic area. Canine ehrlichiosis has been reported in the Indian subcontinent, east Africa, and Israel, but what of other areas in the Middle East or Southeast Asia? Information should be gathered by detailed examination of local veterinary and animal husbandry publications as well as by conducting serologic surveys of local animals. This information might prevent the needless occurrence of another outbreak of canine ehrlichiosis. Prophylactic tetracycline therapy is indicated for dogs entering an endemic area.

The education of veterinary officers, veterinary technicians, and animal handlers to the danger of canine ehrlichiosis is critical. This is especially important when the low-level, subclinical disease

is considered; a German Shepherd with a nosebleed will, of course, get immediate attention, but a German Shepherd with subclinical chronic disease may perform its duties poorly for a whole military career unless the people around it are alert to the danger. Veterinarians as a group are not particularly attuned to arthropod-borne rickettsioses, and canine ehrlichiosis is an almost unknown, or at least unrecognized, clinical entity in civilian veterinary practice. When civilian veterinarians become military veterinarians, they must be trained to recognize the disease and understand its implications for the military working dog program. Veterinary officers must, in turn, train their technicians and animal handlers about canine ehrlichiosis. The animal handler will pick ticks off his dog a bit more enthusiastically if he knows specifically why he must engage in that particularly painstaking task. The closer attention paid to the dogs by handlers and veterinary personnel alike will result in the additional benefit of earlier recognition of other maladies. If the people who work directly with military dogs are not constantly reminded that an epizootic once occurred, and that it could repeat itself, time will gradually erode their awareness of a potentially catastrophic problem.

Additional research studies about canine ehrlichiosis are indicated. Though many questions remain unanswered, research efforts have slowed because canine ehrlichiosis is no longer an acute problem ("acute" is roughly defined here as dogs falling over dead, because the serologic studies previously mentioned certainly establish that ehrlichiosis remains a problem). This paucity of current research

surely reflects both a lack of research funds and the human tendency to wait until disaster strikes before trying to solve an existing problem; but, regardless, some intriguing questions about canine ehrlichiosis remain. What exactly is the immunologic component of the disease? The answer to this question could be extremely useful in explaining the mechanisms of other immunologic diseases in man and animals. Are there strain differences among Ehrlichia canis organisms? Why does the German Shepherd's nose bleed, but the Beagle's does not? If a large number of clinically normal dogs are infected with Ehrlichia canis, why do they not occasionally get sick? Or do they get sick, but veterinarians just do not recognize the disease for what it is? Does the relatively high infection rate evidenced by serologic tests represent an actual increase in the number of infected dogs, or have dogs been the unrecognized host of Ehrlichia canis for decades or centuries? This could make a great medical detective story. The answers to these questions would provide insight into canine ehrlichiosis and potentially useful information about other rickettsial diseases of man and animals.

The broader implications of the canine ehrlichiosis epizootic in Vietnam, those not related directly to ehrlichiosis, are similar and parallel to those already discussed, but wider in scope and probably more meaningful to the future employment of military working dogs. To elaborate these implications is important, because highly specialized scientists, including veterinary scientists, sometimes tend to overlook the forest in their enthusiasm for examining trees.

By far the most important implication of the epizootic for the military working dog program is an understanding of the fragility and vulnerability of canine health to "unknown" or "exotic" diseases, particularly when dogs are employed in unfamiliar environments. This epizootic occurred suddenly and unexpectedly, and other epizootics can, and likely will, occur just as suddenly and unexpectedly. The recent canine parvovirus outbreak serves to graphically illustrate this point. This demonstrates the need for planning to deal with like events in the future, and for understanding that the canine ehrlichiosis outbreak in Vietnam should not have been unexpected; the unexpected is to be expected; what at first seems bizarre is really quite common place. Veterinarians trained in the United States should not expect the canine diseases in Southeast Asia or the Middle East or Africa to be the same as those in the United States; or, if the diseases are the same or similar, he should not expect them to manifest themselves in the same way. "International disease" requires an "international mindset." Acquiring and using this mindset, preferably before dogs arrive in an operational area as well as after they arrive, will reduce the shock of similar epizootics and likely reduce their severity. Canine ehrlichiosis struck dramatically in Vietnam; other diseases will strike again in the future.

More specifically, the canine ehrlichiosis outbreak suggests the need for increased vigilance for arthropod-borne and other diseases. Babesiosis is a good example. It occurred simultaneously with ehrlichiosis in many dogs, confused the diagnostic picture, and perhaps exacerbated the disease. But there are dozens of

arthropod-borne viral, rickettsial, and protozoan diseases just waiting for the unwary dog and unwary veterinarian. This fact points up the need for ongoing international animal disease surveillance, and the special need for veterinary officers to always be familiar with the status of international animal disease. The military veterinary services have a representative to the United States Department of Agriculture's Emergency Animal Disease Program; information prepared by this representative should continually flow to military veterinarians. Special emphasis should be placed on areas where military dogs are employed or where they might be employed. In this regard, special emphasis should be placed on seemingly benign diseases which may become serious in a high-stress combat environment.

The canine ehrlichiosis outbreak in Vietnam, and the veterinary research prompted by the outbreak, indicate that the medical examination of prospective military dogs should be broadened. Since a large number of prospective dogs are infected with ehrlichiosis, serologic screening for ehrlichiosis is clearly indicated and should be followed by the rejection (or, conceivably, treatment followed by intense serologic monitoring) of infected dogs. But is examination for ehrlichiosis enough? How about babesiosis? Should prospective dogs be cultured for salmonellosis? This is not meant to imply that babesiosis or salmonellosis are necessarily of great concern, but that the method of pre-induction examination of military working dogs should be reevaluated and changed as required. The military veterinary services should do so.

Vector and reservior control should be emphasized any time and any place military dogs are used. The need for tick control was clearly shown by the ehrlichiosis epizootic, but the implication is much wider. Mosquitoes, ticks, mites, chiggers, bugs, flies, rats, mice, birds, toads, mammals, reptiles, and others can all serve as vectors or reservoirs of disease. The useful methods for controlling these vectors and reservoirs are limited only by the imagination, but the critical need for effective vector and reservoir control must be emphasized and reemphasized. Again, prior knowledge of the disease vectors and reservoirs likely to be troublesome in a particular area would be useful and might prevent disease. Vector and reservoir surveillance should be an integral part of the international disease surveillance effort, and medical entomologists should be actively involved in this surveillance effort.

The method of housing military dogs, particularly in the field, should be carefully examined. The field environment does not lend itself to luxurious housing for dogs, but, within operational constraints, dogs should be housed to exclude vectors, prevent direct contact between dogs, and eliminate animal wastes sanitarily. Although highly speculative, the ehrlichiosis problem in Vietnam might have been reduced by the field housing of dogs to reduce tick exposure.

The method, frequency, and recording of the periodic physical examinations of military dogs should be reevaluated. The canine ehrlichiosis epizootic demonstrated that some additional

information, notably hematologic information, should be routinely obtained during periodic physical examinations. Currently, a physical examination is required at both origin and destination each time a dog moves from one location to another, and at least one examination is required every six months. These requirements also existed during the Vietnam War, so a dog present for duty in Vietnam was examined several times: upon arrival at Lackland Air Force Base, upon departure from Lackland Air Force Base, probably upon arrival at an intermediate training site (depending on the type of dog), upon departure from the intermediate training site, upon arrival in Vietnam, perhaps during the conduct of semiannual physical examinations, and at any time the dog was reportedly ill. Despite all these physical examinations, the initial hematologic screening of dogs in Vietnam prompted by the epizootic of idiopathic hemorrhagic syndrome revealed a very large number of clinically normal, but anemic dogs. Although it is possible that all these dogs became anemic after arriving in Vietnam, it is more likely that at least some were anemic upon arrival. Nonetheless, the numerous physical examinations of these dogs did not reveal anemia. This indicates the specific need for routine hematologic examination during physical examination, and the general need for a careful review of physical examination procedures. The standardized and meticulous recording of examination results is also essential. A team of veterinary officers intimately familiar with military

working dogs should evaluate the present program for the periodic physical examination of military working dogs, and make appropriate changes to the program.

Veterinarians must establish and enforce strict movement control on all dogs, particularly in unusual environments. Dogs from one geographic area should contact those from another only when dictated by operational requirements. Strict quarantine rules and in-depth rules for the pre-shipment health examination and certification of military dogs should be established and enforced when operationally feasible. The severity of the canine ehrlichiosis epizootic, for example, might have been reduced if rules like these had been established and enforced before the epizootic began.

Veterinarians, veterinary technicians, and animal handlers should exercise increased vigilance when their dogs are exposed to strange environments. This is not to suggest that these groups were inattentive to their dogs during the Vietnam War, only that their degree of vigilance was dictated by the health care environment which existed in the United States, not by the environment in Vietnam. If nobody is looking for an "exotic" disease, chances are that nobody will find one until a catastrophe occurs. Animal handlers should be taught to report the slightest abnormality in their dogs to the veterinary technician, who should be trained to meaningfully report these problems to the veterinary officer and refer patients to him as required. The veterinary officer should also be more vigilant: making as many on-site kennel visits as

possible, developing a close working relationship with everyone involved in the military working dog program, educating others about the dangers to canine health and how to avoid them, and naturally, practicing skillful canine medicine. In short, the veterinary officer should assume a very active role in the care of military dogs; he should not passively wait for the sick dog to be presented for treatment; he should actively be promoting good canine health care.

The need to train veterinary officers, veterinary technicians, and animal handlers about the dangers to canine health is closely related to the need for increased vigilance. This training requirement was discussed with specific regard to canine ehrlichiosis, but the requirement is much broader. The standard curricula of military service schools for veterinary officers, veterinary technicians, and animal handlers should include a block of instruction about "exotic" animal diseases and the demand for increased vigilance to prevent their possibly catastrophic effect on military working dogs. This would not serve to make the students experts about foreign or "exotic" animal diseases, but to alert them to possible problems and make them aware of the resources available to deal with "exotic" canine diseases, resources like the United States Department of Agriculture's Emergency Animal Disease Program and the Walter Reed Army Institute of Research. One major educational goal should be to change the mindset of the students from a national focus to an international one.

The need for additional medical research to elucidate disease problems related to the military working dog is obvious. Canine ehrlichiosis is itself an intriguing problem, but the scope of studies should be much broader. Further investigation of the roles of immunology and stress in canine disease should be fruitful, and useful information about disease in man and other animals would likely result. It is sad that research efforts tend to post-date rather than pre-date the occurrence of disease problems. To some extent, this is the inevitable result of an inability to predict the future, but some problems can be anticipated and intelligently prepared for with research projects. This is especially true if research efforts are guided by analyses of particular geographic areas and an understanding of the canine diseases likely to occur there.

These analyses and research efforts should not necessarily be limited to "test-tube" research. The implications are broader, and may include political, social, and economic dimensions. For example, are there countries in the Middle East that prohibit the entry of dogs that have been vaccinated with modified-live-virus rabies vaccines? Probably not, but, if so, it would be nice to know that fact before modified-live-virus vaccinated dogs have been deployed from the United States, and are being inspected by local health authorities on an airport tarmac in some Middle Eastern country. Prior knowledge would permit the shipment of dogs vaccinated with killed-virus vaccines. The next logical question, of course, would be, "Are there strains of rabies virus in the

Middle East against which killed-virus vaccines from the United States are not effective protection?" Again, probably not, but, if so, the research community could, if given notice, respond to the demand for a new vaccine. Another hypothetical question is: "Are there societies in the Middle East which for cultural or religious reasons would resent or even violently oppose the use of dogs in a security role (remember the objection of our own Congress to Zachary Taylor's use of bloodhounds to track Indians)?" It would be wise to answer this question before rather than after dogs were deployed. The point here has nothing at all to do with rabies or Middle Eastern culture and religion; it has to do with the need for prior planning before dogs are deployed into an operational area.

This prior planning requires the collection, storage, and retrieval of large amounts of information. The computer provides an extremely useful tool in storing and retrieving this information, and, as part of this study, for example, a computer printout of all canine ehrlichiosis cases from Southeast Asia was obtained from the Armed Forces Institute of Pathology. The information was derived from the Registry of Veterinary Pathology sponsored by the American Veterinary Medical Association. The Registry is designed for use principally by veterinary pathologists and includes a great deal of useful disease information.

The purpose of obtaining the Registry printout was to obtain specific information about exactly where and when dogs died of canine ehrlichiosis in Vietnam. The printout was rather disappointing because the "where" and "when" were not specific

enough. For example, all dogs which died of canine ehrlichiosis in Vietnam were grouped under the geographic heading "Indochina and Malay Peninsula, Farimer, India (includes Vietnam)." The contributor of the accession to the Registry is also listed, and, using this additional classification, the reader can generally narrow the broader classification to simply "Vietnam" (although this would be a dangerous conclusion for many contributors, since they receive pathology materials from several countries). In any case, knowing that the case occurred in Vietnam is of limited value. Where in Vietnam did it occur? Similarly, the Registry indicates only the year in which the case occurred. Again, this information is of limited value. When exactly during the year did the case occur? The Registry is designed, of course, principally for veterinary pathologists, not for veterinary epidemiologists, but the addition of a very small amount of information (perhaps two or three words per accession) would permit the reader to pinpoint exactly where the case occurred. This very small additional investment in time, effort, and computer storage space would have made this study, and others like it, much more complete and valuable.

The public relations aspects of the canine ehrlichiosis epizootic have previously been mentioned, but some additional discussion is warranted. Fortunately, the ehrlichiosis problem never caused the military services any serious embarrassment in Vietnam, but the unrealized potential for embarrassment was always there. This may at first seem irrelevant to the conduct of war, but it is in fact extremely relevant.

Warfare is not simply the clash of armed forces on battlefields. Warfare is conflict among societies which pits the entire social, political, economic, psychologic, and military fabric of one society against another. In some cases, the results of the actual armed conflict may be foreordained by other factors (there are those, for example, who contend, justifiably perhaps, that the outcome of World War II was never really in question after American industry entered the war). Armies must reflect the values of the societies they represent, and, if they do not, they will not win wars. The Vietnam War graphically illustrates this point. B. H. Liddell Hart said that, "On (moral factors) constantly turns the issue of war and battle. In the history of war they form the more constant factors, changing only in degree, whereas the physical factors are different in almost every war and every military situation." Hart quotes Napoleon's dictum that "the moral is to the physical as three to one," and says that "in most campaigns the dislocation of the enemy's psychological and physical balance has been the vital prelude to a successful attempt at his overthrow (82)." So there is much more to war than fighting battles. What has this to do with disease in military dogs?

American society is, for better or worse, full of animal lovers, more specifically, dog lovers. If the military forces of the United States send dogs into battle, those dogs had better be well cared for. Society will demand nothing less. News of dogs dying wholesale from dread foreign diseases will not sit well with the American public, so it behooves the military services to

carefully plan for the well-being of their canine belligerents. The canine ehrlichiosis epizootic apparently did not contribute to the ill-feelings generated in American society by the Vietnam War, but the potential for unfavorable public reaction in future wars will remain.

Chapter VI

SUMMARY AND CONCLUSION

Dogs have served with soldiers in war throughout recorded history. The Vietnam War saw several thousand canines serving as sentries, scouts, trackers, and mine detectors. These dogs served the American military well, and, unfortunately, about 250 of them lost their lives in an epizootic of canine ehrlichiosis (tropical canine pancytopenia).

The epizootic began in mid-1968 with the sudden onset of a then unknown, highly fatal disease characterized by acute epistaxis, severe anemia, and death. The veterinarians in Vietnam and the military veterinary medical research community, especially the Walter Reed Army Institute of Research, responded to the challenge, identified the disease, and brought it under control. Sadly, the efforts to identify and control the disease required about two years during which most of the 250 deaths occurred. These veterinarians should be applauded because canine ehrlichiosis was, until that time, an extremely obscure disease, so obscure that it could aptly be called unknown. Had the world's veterinarians been asked in 1967 to list the most dangerous canine diseases that might occur in Vietnam, canine ehrlichiosis surely would not have been listed at all. The disease was just that mysterious. The exigencies of war and the long distance between Vietnam and the medical research base in Washington, D.C. also complicated the attempts to precisely pin down the cause of the

epizootic. If the military veterinary services had not attacked the problem as vigorously and competently as they did, the cause of the epizootic could very well still be unknown.

The ehrlichiosis epizootic caused the death or disability of hundreds of military working dogs in Vietnam. From mid-1968 until the end of the United States involvement in the war, but especially through the end of 1969, the epizootic constantly reduced the overall effectiveness of military dog units. The effect of canine fatalities is obvious, but less obvious are the deleterious effects of quarantines, the constant need for physical examination and treatment of dogs, and the less than optimal performance of those dogs able to work, but not able to work at peak efficiency.

The epizootic cost large amounts of money, certainly hundreds of thousands of dollars, probably millions. It was costly in manpower as well; the epizootic strained the manpower resources of the veterinary service in Vietnam, and idled many dog handlers for long periods. Consequently, canine ehrlichiosis was undoubtedly the single most serious obstacle to the effective employment of military working dogs during the Vietnam War. Hopefully, some lessons have been learned and past mistakes will not be repeated.

The canine ehrlichiosis epizootic and the fact that Ehrlichia canis organisms still infect many military working dogs illustrate the need for continued concern with this disease. Specifically, prospective military dogs should be serologically screened for ehrlichia organisms before purchase, and dogs on active duty should be

periodically tested and treated as required. Rigorous tick control must be emphasized, the disease threat should be evaluated before dogs are introduced into an area of operation, and veterinary officers, veterinary technicians, and animal handlers should constantly be alert to the threat of this disease.

More generally, this epizootic demonstrates the susceptibility of canine health to unexpected disease, particularly when dogs are exposed to unusual environments. Arthropod-borne disease is a special hazard, and a high-stress environment increases the disease risk. Before dogs are deployed in a new location, the disease risk must be evaluated and plans prepared for controlling likely disease problems. Veterinarians must think in international terms; their awareness of potential problems is critical.

Developing this awareness requires information, and information can be obtained in advance only by the collection of worldwide veterinary intelligence. The veterinarian should have an increased role in medical intelligence gathering, and the United States Army Veterinary Corps should train officers in foreign animal disease surveillance and medical intelligence gathering. These specialists can be trained in both civilian and military schools, and they can serve as conduits of information to the other officers in the Veterinary Corps. The dissemination of foreign animal disease information is paramount, and would pay a large bonus if the United States were confronted with a foreign animal disease on its own soil.

Another lesson of the ehrlichiosis outbreak was that veterinary command and control should be highly centralized in a theater of

operations. This centralization, present in Vietnam, assured a prompt response to the epizootic, while a decentralized command and control structure might have resulted in considerable lost time and more dead dogs. The size of the veterinary service is small enough to permit highly centralized control, therefore centralized control should be the rule in employing veterinary resources. This centralization will also facilitate accomplishing the food inspection mission.

The dichotomy of interests and reporting between the operational personnel involved with military dogs in Vietnam and the veterinary personnel has already been mentioned. The operational personnel generally did not mention the disease in their reports because they considered it a medical matter, while the veterinary personnel did not mention the disease's effects on military operations because they considered that an operational matter. This dichotomy seriously inhibited this study's ability to outline the exact operational impact of canine ehrlichiosis. In the future, an attempt should be made to integrate the medical and operational effects of disease when disease problems are reported. This could be done by operational personnel, veterinary personnel, or military historical units.

A comprehensive history of the military veterinarian's role during the Vietman War should be written. A comprehensive history would be an invaluable tool for future military veterinarians.

The military veterinary services have recently been under severe attack by those in the Department of Defense and elsewhere who feel that military veterinarians are an anachronism in a modern military force. The United States Air Force Veterinary Service became a

casualty of this attack in March 1980, and the United States Army Veterinary Corps was wounded by severe manpower limitations with additional manpower cuts planned in the future. Without becoming embroiled in the controversy about the need for military veterinarians, or expanding this study beyond its scope, it can safely be stated that the outbreak of canine ehrlichiosis in Vietnam graphically demonstrates the requirement for military veterinarians. Had there been no military veterinarians, a serious problem would probably have been catastrophic. Dogs would have died wholesale, military dog operations would likely have ceased altogether, and a storm of public outrage might well have fueled an already smoldering public discontent over the conduct of the war. Those critical of the military veterinarian should think about that, and military veterinarians should not hesitate to point with pride to their role in the epizootic of canine ehrlichiosis.

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