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DIRECTOR OF SHIP MATERIAL

BUREAU OF MEDICINE AND SURGERY RESEARCH GROUP

REPORT

[redacted]

THE GROSS AUTOPSY FINDINGS AND A STATISTICAL STUDY OF THE MORTALITY IN THE ANIMALS EXPOSED AT BIKINI

UNCLASSIFIED

Classification (Cancelled) Memo. Ch. Sec Div. 10/14/57
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APPENDIX NO. 3

TO THE FINAL REPORT

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OPERATION CROSSROADS

JOINT TASK FORCE ONE

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Incl 2

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DIRECTOR OF SHIP MATERIAL

NAVAL MEDICAL RESEARCH SECTION [redacted] 1948

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1 March 1947

(6) OPERATION CROSSROADS.

THE GROSS AUTOPSY FINDINGS AND A STATISTICAL STUDY OF THE MORTALITY IN THE ANIMALS EXPOSED AT BIKINI.

(21) Report of [redacted] Medical Research Section, Joint Task Force ONE, on Biological Aspects of Atomic Bomb Tests.

See also Appendix 2, AD-4 13 885.

(9) Appendix No. 3 to Final rept.,

by

(10) JOHN C. TULLIS.
~~Commander, MC, USN~~

(11) 1 Mar 47,

(12) 14

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Approved:
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THE GROSS AUTOPSY FINDINGS AND A STATISTICAL STUDY OF THE MORTALITY IN THE ANIMALS EXPOSED AT BIKINI

Introduction

Operation Crossroads, planned originally to observe the effect of atomic bombing on naval vessels at anchor, presented in addition a unique opportunity to study the effect of massive ionizing radiations on living experimental animals. The information obtained from observing the tissue response to atomic bombing is of medical, industrial, and military interest. The manufacture of the elements and vehicles of atomic energy and its subsequent use, either industrial or military, will present many new hazards to health. Methods for the prevention, diagnosis and treatment of ionizing radiation injuries should be familiar to all physicians.

Experimental study of the biologic response to atomic bombing is an undertaking of such magnitude that it is not likely to be repeated frequently. The importance of the experiment and the rare privilege of participating was realized by every member of the Naval Medical Research Section of Operation Crossroads. In shaping up the experimental procedures aid was obtained from scientists in civilian life, and in the Army, Navy, and Public Health Services. The limitations of the experimental conditions were fully anticipated; in fact, our estimates turned out to be overly pessimistic for the skillful direction of the task force, the ability of the technical participants and the favorable bombing conditions made it possible to set and maintain a strict schedule for the experiment. Some objectionable features could not be overcome for they were an integral part of the conditions of the experiment. The more obvious of these include the tropic heat, the necessity for transporting large numbers of animals over several thousand miles of ocean, the difficulties of small boat transportation between laboratory ship and target ships and finally, the delayed recovery of animals where residual radioactivity made an area unsafe for personnel.

Goats, pigs, white rats and a few guinea pigs were selected for exposure to the air burst in test "ABLE", while pigs and rats only were exposed in the underwater blast in test "BAKER". The choices proved good ones for the animals became adjusted to and thrived in their floating home in the tropics.

The positions used in animal placement on the target ships were chosen for coverage of the ship from mast-head to below the water line and from bow to stern. Rats hoisted on signal halyards were exposed without any protection while other animals were partially protected by gun splinter shields or took crew members places in the pilot house, in the armored gun turrets, in sleeping quarters, in the sick bay, in the holds and in armored parts of ships. In general, in test "ABLE", the goats were placed in the more exposed the pigs and guinea pigs in the more sheltered locations. Ten or more rats were also placed at each location. For test "BAKER" the operating room on four attack transports (APAs) were the only locations used.

Our greatest fear was that the animals would be deprived of water following the test, but the early recovery of animals and the rugged watering devices installed in cages and pens solved the problem. No large animals and only a few of the rats were without water at the time of recovery. Dehydration was not the principal cause of death in any of the animals, but it may have contributed to the death of some, particularly in the first day or two after exposure. No animal was without food at the time of recovery. The highest inside temperature recorded in the tightly "buttoned down" target ships containing goats and pigs was 107° F. For goats raised in southern Texas and pigs from a ranch near Sacramento, California, this temperature should not have been too disagreeable and according to clinical observation was not. The ship's arrival in the target area two weeks before Able Day allowed an ample period for local acclimatization.

The smooth operation of the test schedule, the base line studies on the animals, the toil and sweat of planning, preparation, and execution would have gone for naught without the able and willing cooperation of the volunteer civilian, Army, and Navy doctors who performed autopsies in the peak load week following the tests. Heat and humidity form a vicious combination favoring rapid decomposition of dead tissues. With the help of the volunteers many animals which rapidly would have become valueless were salvaged for study.

EXPERIMENTAL DESIGN

I. Target Ships

Twenty-two ships of the target array were chosen for placement of the animals for test "ABLE". Seven of these ships were APAs of the same class and were anchored at intervals from 1000 to 3200 yards along a south by east radius from the USS NEVADA. The trade wind blows from the northeast quarter which allowed the fission products in the cloud to be carried away from the main animal target line toward the southwest. The direction of the trade wind was the chief deciding factor leading to our choice of the seven APAs along with the USS INDEPENDENCE, the USS SALT LAKE CITY, and the USS PENNSYLVANIA in the southeast quadrant of the target array. The remaining twelve ships selected for placement of animals included the USS NEVADA and SAKAWA near the target center and ten ships of varied types which were anchored in scattered positions in the target array. Five of the target ships were downwind from the target center.

For test "BAKER" four APAs of the same class anchored at 716, 950, 1326, and 1560 yards from the bomb raft were the target ships selected for the placement of animals.

Figures one and two indicate the approximate locations of the target ships which housed the experimental animals in the bomb trials.

II. Animals

(a) Goats - One hundred seventy-six goats chiefly in the age group of one to two years and of the Angora breed were exposed to the bomb burst in test "ABLE". Eighty-six of these were males and ninety females. The Angora breed was chosen for its small size (40-60 pounds) and gentleness. The small percentage of mixed breeds in the herd, although they were larger animals, caused no insurmountable difficulties. Twelve males and seventeen female goats were kept aboard the USS BURLESON to act as controls. Four of the test goats were provided by Cornell University and have been returned to that institution for further study in the department of psychology. Fourteen goats were depilated, smeared with different kinds of anti-flash burn cream, and were placed in exposed locations on seven APAs during test "ABLE" in order to evaluate the flash burn component of the bomb. This study is reported in Appendix No. 19.

(b) Pigs - One hundred forty-seven pigs, herd-mates of mixed Poland-China, Duroc-Jersey, and Chester White breeds and averaging three and one half months of age at time of exposure, were placed on target ships for test "ABLE". Seventy-five were males and seventy-two females. Forty-eight pigs aboard the USS BURLESON acted as controls.

For test "BAKER", which was conducted 24 days after test "ABLE", twenty pigs that had acted as controls for test "ABLE" were divided equally between an APA anchored 716 yards from the bomb raft and one at 1326 yards. In anticipation of a delayed reentry to the target ships, a self-filling water trough supplied by a 300 gallon tank and a self feeder with a week's supply of grain and hay were provided for each group of 10 pigs.

(c) Guinea Pigs - In test "ABLE" two groups each containing 28 mixed breed guinea pigs were placed aboard target ships, one group below decks on a ship at 1700 yards and the other in the pilot house on a ship at 2200 yards. The guinea pigs were from the hybrid colonies of the National Institute of Health at Bethesda, Maryland.

(d) Three thousand thirty white rats were placed five to a cage on the various target ships for test "ABLE". Of these, eight hundred fifty were subjects for special study by the U. S. Army Medical Corps, the Chemical Warfare Service of the U. S. Army and the Bacteriological Warfare Service. Reports on these experiments will be prepared by the groups responsible and will appear separately.

The sexes of the rats were about equally divided and were kept segregated in-so-far as possible. It was necessary to accept several strains of albino rats to complete our requirements. All proved satisfactory except one shipment which was detained by a railroad strike. On arrival many of these rats were dead and others showed signs of encephalitis. The diseased rats were destroyed and at no time was the general colony involved in any type of epidemic. Six hundred eighty-seven rats were maintained as

[redacted]

For te[redacted]ce on board the target ships on A minus ten (A-10) day to A-4 day. Distribution of the animals to their test stations was accomplished from A-2 to A-½ days. For test "BAKER" all animals were placed in final position on B-1 day.

Six boarding teams which had placed the animals prior to the test reentered the target area as soon after the tests as the ships were cleared by the Radiological Safety Section. The animals were returned to the USS BURLESON where they were individually monitored for radioactivity and handled accordingly. Those alive were placed in special pens and cage racks for observation. Those dead were removed to the autopsy room for dissection and study. Three groups of 100 rats each placed in the pilot houses of three ships at approximately 1000, 1500, and 2100 yards from the USS NEVADA were killed daily in groups of 30 beginning A plus 4 day. Also from time to time control goats, pigs and rats were killed for study.

Tissue blocks from all organs of the animals autopsied were preserved in 10% neutral formalin and in Bouin's solution. Microscopic sections of this material have been prepared at the Naval Medical Research Institute.

Results

The atomic bomb contains all the explosive characteristics of TNT magnified many times. In addition, it produces ionizing radiations which distinguishes it from all other bombs. The general mortality percentages for the animals exposed in the bomb tests (figures 3 and 4) take into account deaths from all phases of the destructive power of the atomic bomb including air blast, thermal radiation, secondary fire and ionizing radiation. Loss by drowning is not included. It is not always possible to rule out certain factors which may have played a part in bringing about death, but in the Bikini tests ionizing radiation accounts for by far the greatest

mortality observed. The animals placed for the "BAKER" test were shielded from all bomb effects except that of ionizing radiation. The mortality percentages in figure 4 represent, therefore, deaths caused exclusively by ionizing radiation. The animals that died within a 30-day period after "A" day followed a fairly definite pattern of lesions characteristic of radiation sickness. The variations seen were variations in intensity with only a few variations in kind. The deaths that occurred after the first thirty days were only secondarily attributable to atomic bomb injuries. All animals that died primarily of lesions produced by the atomic bomb died within the first thirty days after the tests.

Pigs reacted similarly to the goats in test "ABLE" and their lesions are comparable to those in the goats. The pigs in test "BAKER" show larger and more diffusely distributed hemorrhagic and and ulcerative lesions than do any of the animals in test "ABLE". In test "BAKER" it is emphasized that not only were the animals subject to irradiation from the initial bomb burst, but in addition the target ships were showered with fission products that clung to the surface of the ships and continued to irradiate the animals until they were removed. The "BAKER" animals received more total body radiation than did any of the "ABLE" animals and their lesions were therefore more severe, death occurred sooner and mortality was higher in locations where comparable amounts of shielding were afforded. The curves in figure 3 have not been corrected for various amounts of shielding. Since identical locations on sister ships were used in test "BAKER" the curves in figure 4 are comparable for shielding and, therefore, reflect a more accurate picture of the lethal effect of the atomic bomb.

Figures 5 to 9 indicate mortality percentages as functions of distance and roughly comparable amounts of shielding. Open weather decks, signal halyards and interior pilot houses are the three locations chosen for comparative mortality studies. The curves indicate that rats are more resistant to radiation than goats (compare figure 5 with 7 and figure 8 with 9), that the pilot house structure affords some slight protection from the effects of the bomb (compare figure 5 with 8 and figure 7 with 9) and, finally, it would appear that ships located at 1500 yards or less from the hypo-center of detonation, with the type bomb and height of detonation that prevailed in test "ABLE", would suffer serious losses in man power within 30 days after the explosion.

Because we were not always able to distinguish the cause of death in some of the animals which were found dead, and often badly autolyzed at time of reboarding all such animals were excluded from the data used to compile the mortality percentages. In other words, our computations are based on known bomb deaths and do not include deaths from causes other than those which can be attributed to the bomb alone. Our approach, therefore, if it errs, does so on the conservative side rather than on the excessive.

Review of figure 3 which is baed on total mortality from all causes, except drowning, shows that at comparable distances the curves although higher show the same slopes as the curves in figures 5--9 which are based on "adjusted" mortality.

Tables 1--22 list for Test "ABLE" and tables 23--26 list for Test "BAKER" the number of animals placed, the number dying at various intervals, the number killed for study and the number remaining alive as of 1 March 1947. These data are further broken down to show mortality by test location (different amounts of shielding) as well as by time interval. The tables are arranged numerically to indicate increasing distance from the point of detonation. The ideal arrangement of these mortality tables will be possible when physical measurements of the actual amount of radiation at various test locations is known. Thus the mortality rate for any one species of animal at all locations receiving the same amount of radiation should be roughly the same and the curves drawn from these data should be essentially straight lines. In time this information will become available and will aid considerably in evaluating the effectiveness of the bomb.

The typical clinical picture of a goat or a pig, and to a lesser degree a rat, exposed to a lethal but not overwhelming dose of ionizing radiation shows an animal which at first looks and acts normally. The total white count decreases within a few hours due chiefly to a fall in the lymphocytes, but within a few days the segmented cells decrease as well. At the end of a week or ten days the red blood cell count shows a corresponding decrease. At this time or a little later the clotting and prothrombin times increase, clot retraction is altered and in some instances the bleeding time is increased. After the first two or three days of apparent well-being the animal develops diarrhea which in a week may become grossly bloody or tarry or both. The animal stays on its feet, but it is hyper-irritable and even belligerent at times. It may take water, but often refuses food. As the anemia progresses, especially if the diarrhea persists, weakness develops and the animal spends considerable time lying down. In the large animals, rapid panting respirations are often present from the first day or two after exposure to the bomb burst. The animal usually responds when approached and struggles to its feet, even walks, until suddenly it dies. Death is often unexpected from clinical observations alone. The diarrhea may subside and even the respiratory distress abates. The animal may appear to improve clinically, but if the lethal dose of ionizing radiation has been exceeded, death is the inevitable outcome.

The gross pathologic lesions in goats and pigs which had died from overexposure to ionizing radiations were very similar. Hemorrhage was the most striking feature of the condition and almost any or every organ and tissue in the body was involved. In the very early stages of the disease engorged vessels of brain, heart, lungs, mesentery, bowel, or other tissues were the only findings. Usually a few scattered petechiae were found in these tissues along with the general hyperemia. The visceral

pleura and the epicardium were favorite sites for the earliest petechiae. If the dose of ionizing radiation was intensive the lesions became widespread, more numerous and larger. If the animal survived for five to ten days many petechiae expanded to ecchymoses or, occasionally, to small hematomas.

In about 80 per cent of the cases the lungs were mottled dark red and pink, the cut surface was wet and sometimes dripped bloodstained fluid, and the bronchi were filled with abundant pink or white froth. The dark red patches were irregular but usually sharply outlined and firm. A few such patches were scattered through the lungs of most of the animals which had hemorrphages in other tissues.

The organs next most frequently involved and often in combination, were the heart and the gastro-intestinal and genitourinary systems. Hemorrhage into all three layers of the heart was common in goats, pigs, and guinea pigs but was seen less frequently in the more radiation-resistant rats.

The gastro-intestinal tract presented especially interesting lesions manifested chiefly in that portion of the large intestine between the ileocecal valve and the descending colon although sometimes the descending colon and the distal ileum were involved. In the first three or four days after exposure acute ulceration of the large intestine sometimes occurred in the absence of gross hemorrhagic lesions. The ulcers were small, irregular and often elongated in the longitudinal axis of the bowel. They were always superficial and never extended deeper than the submucosa. Covering the surface were tenacious, feces-stained, fibrin membranes which were removed with difficulty leaving a raw and moist surface beneath. Later, similar ulcerations were surrounded by mucosal buds that were large, edematous, and hemorrhagic. The lymph nodes draining these areas were dark red, large and moist. Although the layers of the bowel external to the mucosa were usually edematous and hemorrhagic, often spotted with petechiae, there was no evidence of perforation or peritonitis.

In the upper gastro-intestinal tract ulcerations were seen in the pharynx opposite the base of the tongue. They were the same shallow, fibrin-covered, irregular ulcerations seen in the colon and they appeared to spread from areas of petechial hemorrhage. The stomach sometimes contained similar ulcerations. Usually the small intestine showed petechial hemorrhages in the muscle layer, but the mucosa appeared normal. However, the pigs exposed in the "BAKER" test sometimes showed ulcerations in the mucosa of the entire small intestine as well as in the stomach and large bowel. The ulcerations of the small intestines were accompanied by less edema and usually were not covered with the fibrinous membrane. The most extensive gastro-intestinal lesions were found in the pigs exposed in the "BAKER" test. Less extensive lesions were found in the "ABLE" pigs and "ABLE" goats. Likewise, the "BAKER" rats showed more numerous and more intense gastro-intestinal lesions than did the "ABLE" rats. Such lesions were rarely found in the "ABLE" rats, but in "BAKER" rats pin-point

ulcerations of stomach mucosa, with large blood clots filling the stomach, lumen and tarry material filling the bowel, were the rule in about 90 per cent of the cases autopsied.

In the cases receiving large amounts of ionizing radiation among both goats and pigs petechial hemorrhages in the kidney cortices and pelvic walls were common. Gross hemorrhage with blood clots in the kidney pelves was seen occasionally in the larger animals. The genito-urinary lesions in guinea pigs were confined to petechiae in the kidney substance, but this was rarely seen in the rats.

The diaphragm over the spleen was a favorite location for rather extensive extravasation of blood in goats and pigs. In guinea pigs widespread hemorrhage into the muscles of the back, the abdomen, the legs, the chest, and the diaphragm was a fairly constant and very striking manifestation of radiation. The intramuscular hemorrhage was the most characteristic lesion in the guinea pigs. It was practically never seen in the rats, but was occasionally seen in goats and pigs.

In all species the lymph nodes, particularly of the cervical, preaortic, mesenteric, and inguinal regions, were characteristically hemorrhagic. Usually the nodes were enlarged but their chief distinguishing feature was their dark red color, interspersed on the cut surface with patches of moist grey lymphoid tissue.

The brain and meniges sometimes contained a few petechial hemorrhages. The liver, spleen, and adrenals were essentially normal. The bone marrow was sometimes pale and sometimes hyperemic without obvious relation to the general disease state of the animal. The skin showed purpuric lesions more often in the "BAKER" pigs than in the other animals. Depilation was infrequent.

Summary and Conclusions

Clinical observations are readily correlated with the pathologic findings. Severe radiation sickness is associated with depression of the hematopoietic centers and increased capillary permeability. Capillary dilatation and probably damage to intercellular cement substance combine to bring about extravasation of blood which is recognized clinically as petechiae, ecchymoses and, sometimes, small hematomas. Ulceration of the gastro-intestinal tract when it occurs causes diarrhea and, also, is responsible for considerable blood loss. The three factors of depression or destruction of the blood forming centers, the loss of blood into the tissues and the loss of blood externally are largely responsible for the leukopenia and anemia. Direct action of the ionizing radiations on the circulating white blood cells may account in part for the leukopenia.

Both the anemia and leukopenia were responsible for the weakness, irritability, lowered resistance to infection and agranulocytic ulceration. Pneumonia was a common cause of death in the animals which had received

lethal doses of radiation and died within the first week or ten days after exposure in test "ABLE." In the "Baker" animals also pneumonia was common.

Severe burns were few in number as predicted. The exposed animals were well protected by their fur and in those cases where anti-flash burn cream was applied to the depilated skin, full protection was offered by this means. These observations serve to emphasize the protective value of clothing and anti-flash burn creams.

From the data presented several conclusions seem justified. (1) Ionizing radiations of the atomic bomb are lethal for goats, pigs, guinea pigs, and rats exposed to them under various conditions. (2) The pathologic findings are fairly characteristic and similar in the four species studied. (3) The sensitivity to ionizing radiations varied somewhat among the four species, the guinea pigs being by far the most sensitive, the pigs being slightly more sensitive than the goats and the rats comparatively resistant. (4) The flimsiest of shielding seems to afford ample protection from thermal radiation, but heavy armor is not always sifficient to protect against the ionizing radiations. (5) Biologically an underwater explosion is more efficient than an air burst. The spray which showers down on the ships in the vicinity of the underwater explosion carries with it fission products which adhere to the surface of the ship, cannot be easily washed off and remain dangerously radioactive for long periods of time. (6) Ships located within 1500 yards of the center of either an air or underwater atomic bomb detonation would suffer serious losses of man power. The greatest losses would occur immediately and on those ships nearest the explosion, but deaths from the delayed effects of ionizing radiation injuries would continue for at least a thirty day period. (7) After the first thirty days the deaths that occurred were not primarily associated with atomic bomb injuries.

Acknowledgment

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C. F. Wilson, LTJG, USN

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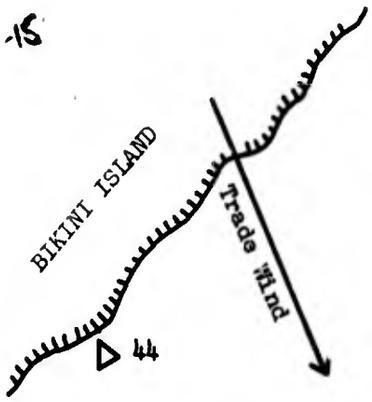
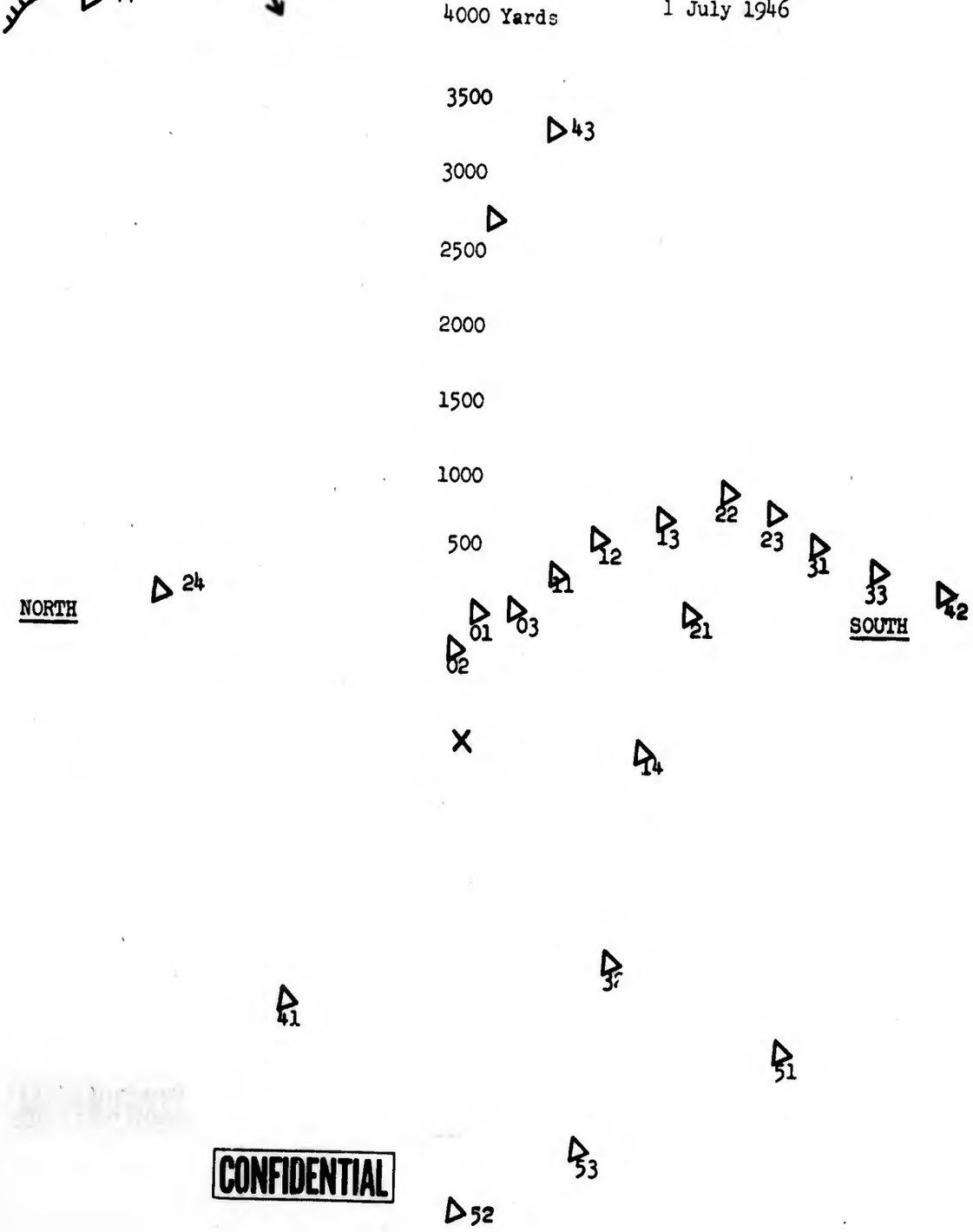


FIGURE 1

Target Array (Approximate)
Experimental Animals
TEST ABLE
1 July 1946



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EAST

FIGURE 2

Target Array (Approximate)
Experimental Animals
TEST BAKER
25 July 1946

4000 Yards

3500

3000

2500

2000

1500

1000

500

NORTH

SOUTH

WEST

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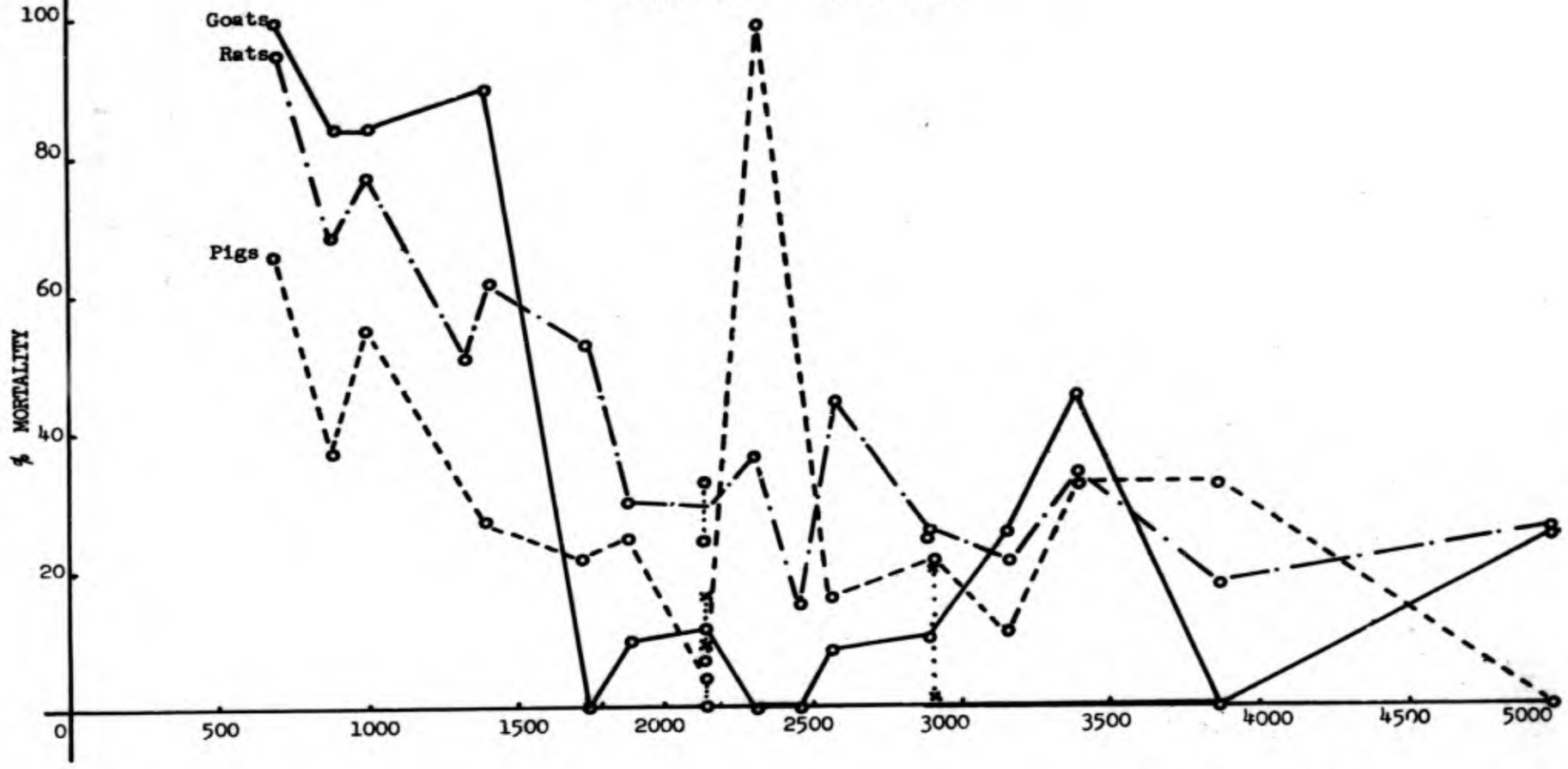
FIGURE 3

PERCENTAGE ANIMAL MORTALITY AS
RELATED TO DISTANCE FROM HYPOCENTER
TEST ABLE

1 JULY 1946 - 1 JANUARY 1947



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PERCENTAGE ANIMAL MORTALITY AS
RELATED TO DISTANCE FROM ZERO POINT
TEST BAKER
25 July 1946 - 1 January 1947

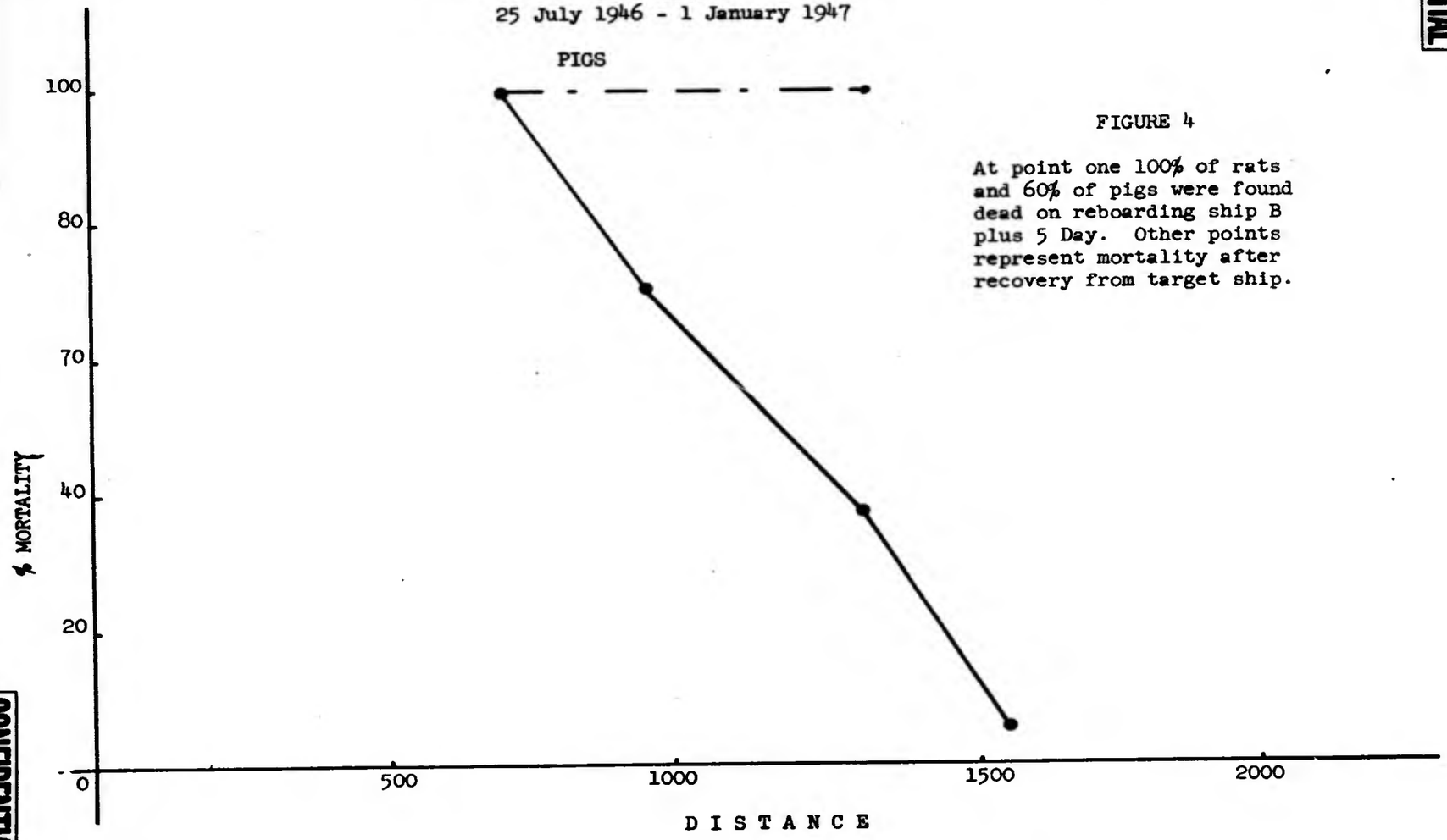

FIGURE 4

At point one 100% of rats and 60% of pigs were found dead on reboarding ship B plus 5 Day. Other points represent mortality after recovery from target ship.

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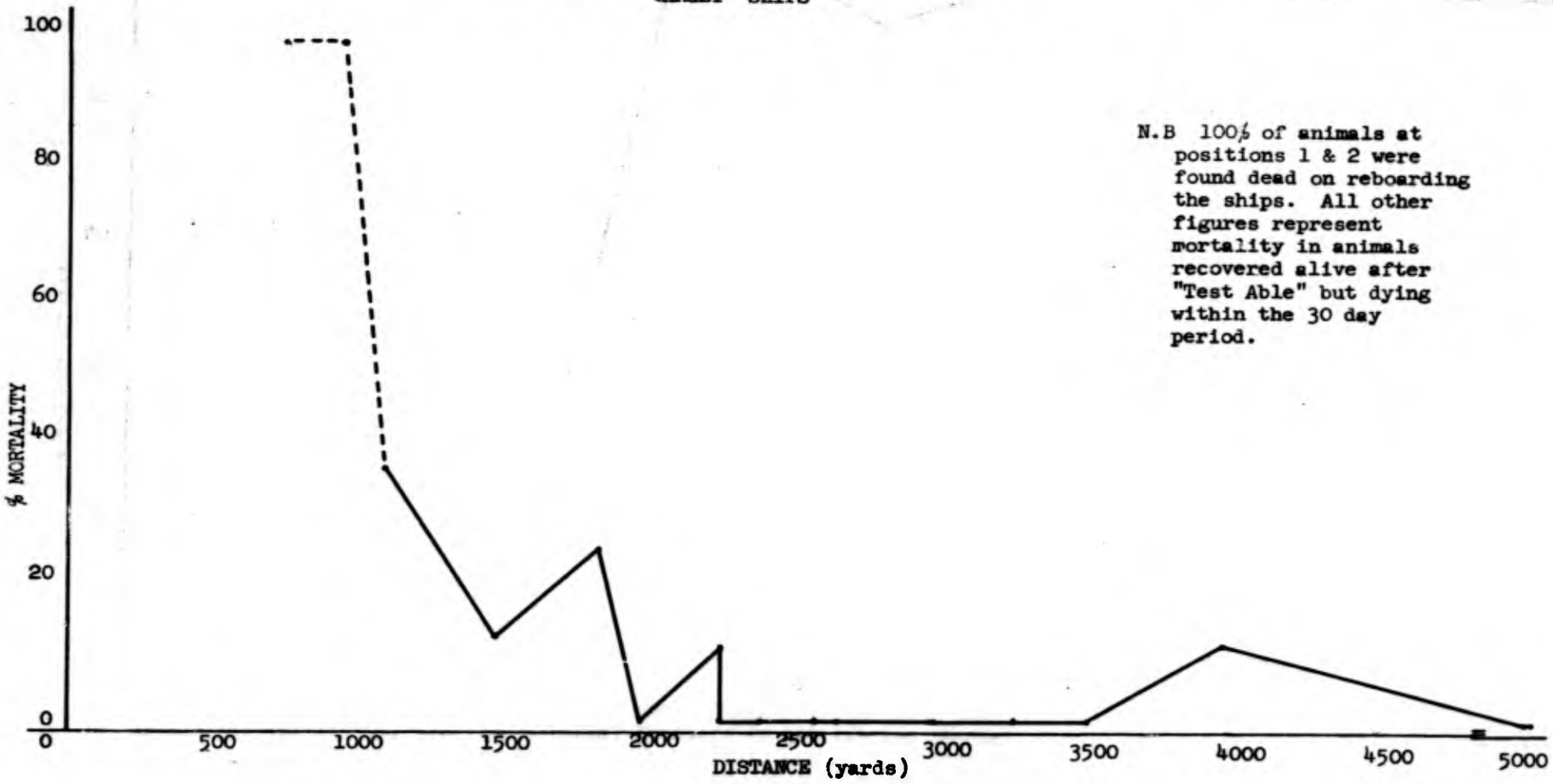
FIGURE 5

PERCENTAGE MORTALITY FOR THE PERIOD OF 30 DAYS FOLLOWING "TEST ABLE" FOR RATS PLACED IN EXPOSED, UNSHIELDED LOCATIONS ON THE VARIOUS TARGET SHIPS



N.B 100% of animals at positions 1 & 2 were found dead on reboarding the ships. All other figures represent mortality in animals recovered alive after "Test Able" but dying within the 30 day period.

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FIGURE 6

PERCENTAGE MORTALITY FOR THE PERIOD OF 30 DAYS FOLLOWING "TEST ABLE" FOR RATS HOISTED ON SIGNAL HALYARDS ON THE VARIOUS TARGET SHIPS AND RECOVERED ALIVE AFTER THE TEST

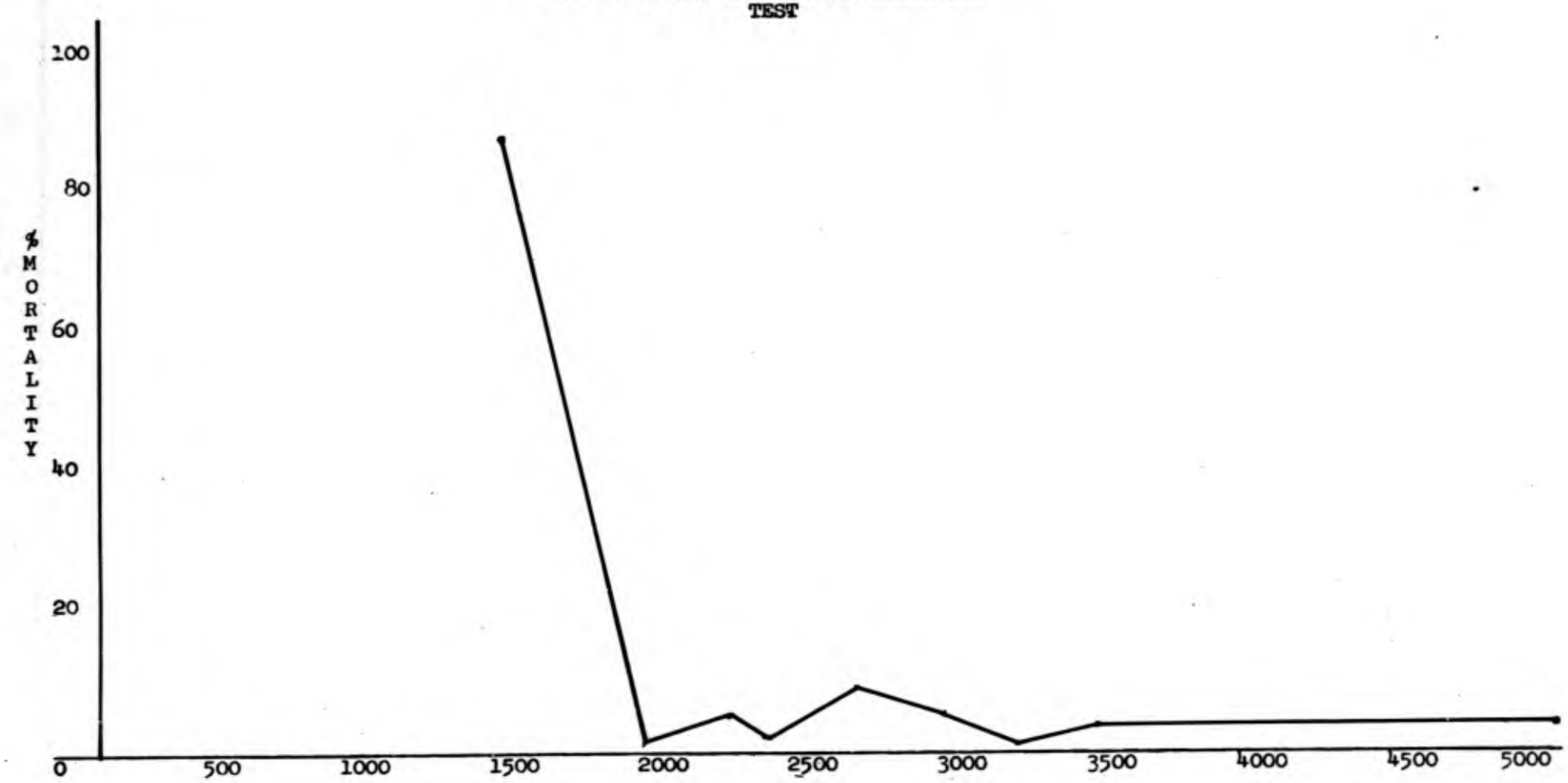

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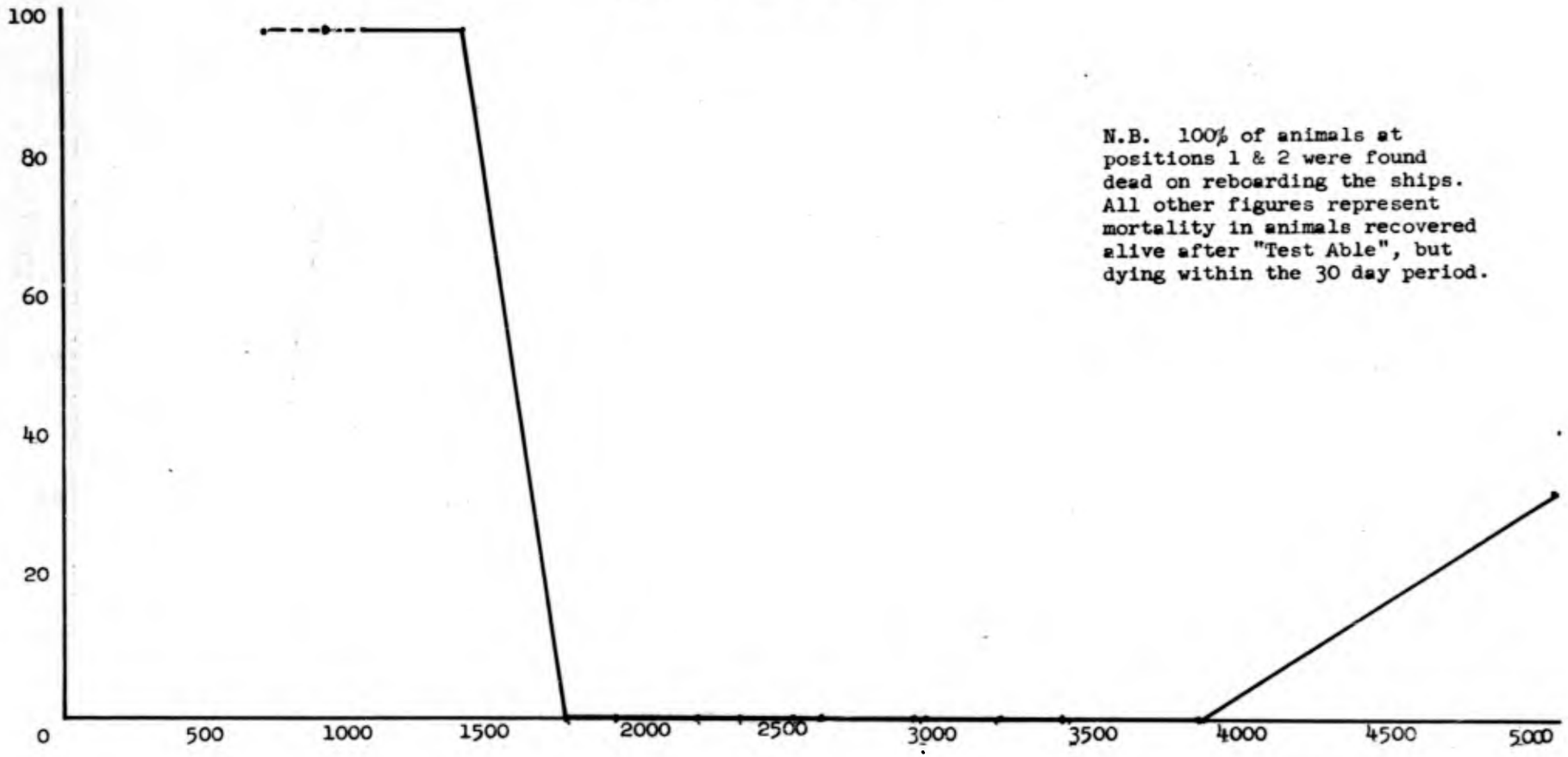
FIGURE 7

PERCENTAGE MORTALITY FOR THE PERIOD OF 30 DAYS FOLLOWING "TEST ABLE" FOR GOATS PLACED IN EXPOSED, UNSHIELDED LOCATIONS ON THE VARIOUS TARGET SHIPS



N.B. 100% of animals at positions 1 & 2 were found dead on reboarding the ships. All other figures represent mortality in animals recovered alive after "Test Able", but dying within the 30 day period.

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FIGURE 8

PERCENTAGE MORTALITY FOR THE PERIOD OF 30 DAYS FOLLOWING "TEST ABLE" FOR RATS PLACED IN THE PILOT HOUSES ON THE VARIOUS TARGET SHIPS AND RECOVERED ALIVE AFTER THE TEST

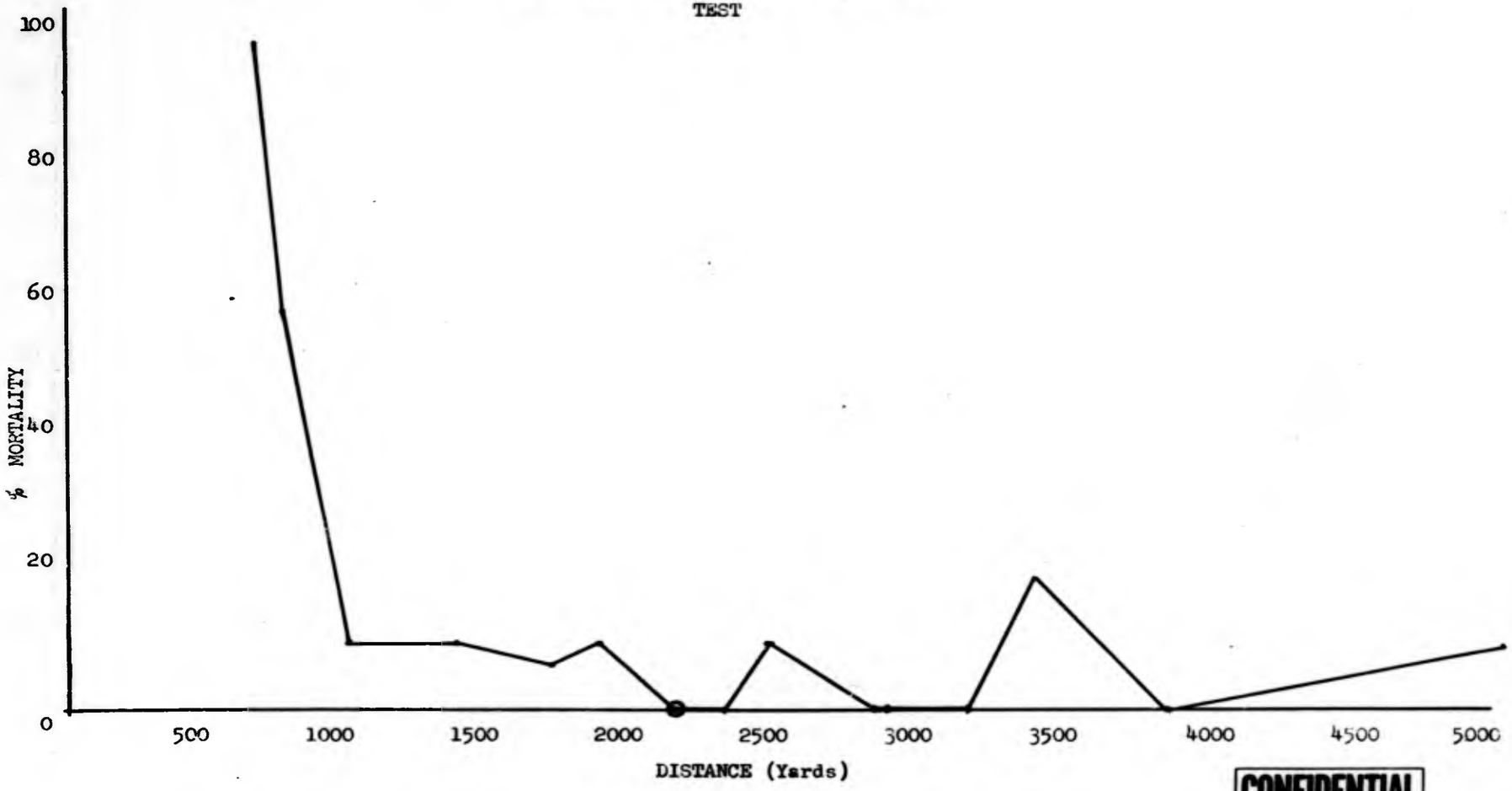

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FIGURE 9

PERCENTAGE MORTALITY FOR THE PERIOD OF 30 DAYS FOLLOWING "TEST ABLE" FOR GOATS PLACED IN THE PILOT HOUSES ON THE VARIOUS TARGET SHIPS AND RECOVERED ALIVE AFTER THE TEST

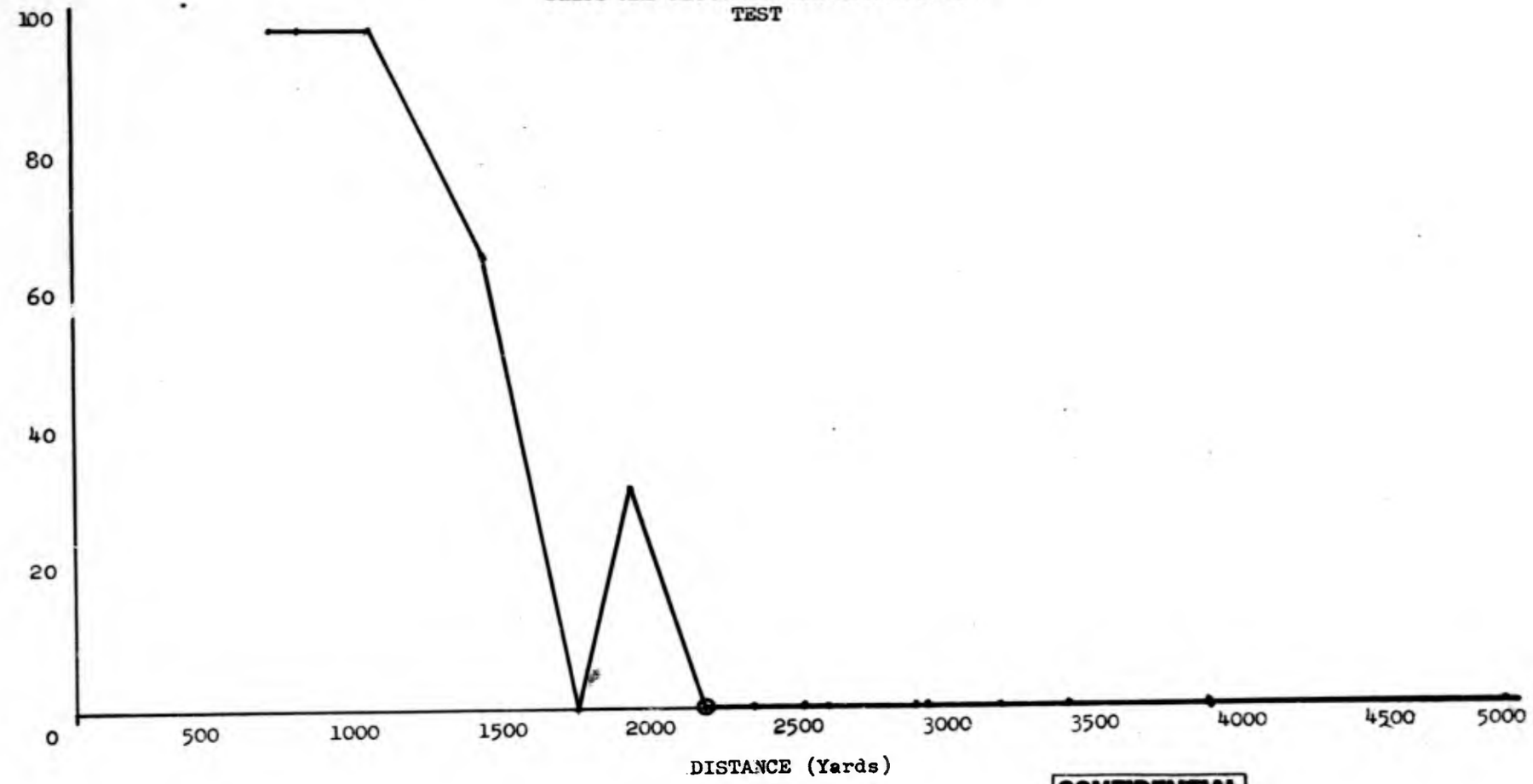

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TABLE 1

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS INDEPENDENCE CODE # 03

LOCATION & SPECIES	NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
05 GOATS	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
PIGS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
17 PIGS	3	-	-	1	-	-	-	-	-	-	-	—	—	—	—	—	—	2
RATS	10	5	2	-	1	-	-	-	-	1	-	—	—	—	—	—	—	1
26 GOATS	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
RATS	10	6	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	0
35 PIGS	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	0
RATS	10	-	7	1	1	-	-	-	-	-	-	—	—	—	—	—	—	1
37 PIGS	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
RATS	10	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
42 GOATS	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
RATS	10	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0

TABLE 2

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS NEVADA CODE # 01

LOCATION & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
03	GOATS	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	PIGS																		
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
12	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	—	3
	RATS	10	-	1	-	-	-	-	-	2	1	-	—	—	—	—	—	—	6
21	GOATS	2	-	-	-	-	1	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	-	-	-	-	-	1	1	-	-	-	—	—	—	—	—	—	7
24	GOATS	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	-	5	4	-	-	-	-	-	-	-	—	—	—	—	—	—	1
28	GOATS	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
35	PIGS	3	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	-	8	1	-	-	-	-	-	-	-	—	—	—	—	—	—	1
37	PIGS	3	-	-	1	-	-	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	5	-	1	-	-	-	-	1	-	1	—	—	—	—	—	—	2
42	GOATS	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	-	-	6	1	-	-	-	-	-	—	—	—	—	—	1	1	1

TABLE 3

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS SALT LAKE CITY CODE # 11

LOCATION & SPECIES	NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
02 GOATS	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
PIGS																		
RATS	10	2	3	-	-	2	-	2	-	-	-	—	—	—	—	—	—	1
22 GOATS	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
RATS	10	3	1	3	1	1	-	1	-	-	-	-	-	-	-	-	-	0
23 GOATS	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
35 PIGS	3	-	1	-	1	-	-	-	-	-	-	—	—	—	—	—	—	1
RATS	10	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
36 PIGS	3	-	-	1	-	-	1	-	-	-	-	—	—	—	—	1	1	1
RATS	10	-	-	-	-	2	1	-	1	-	-	—	—	—	—			4
42 GOATS	3	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	0
RATS	10	-	1	-	3	-	-	-	-	-	1	—	—	—	—	3	—	2
65 PIGS	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0
RATS	10	-	-	1	1	2	-	-	1	-	—	—	—	—	—	—	1	4

TABLE 4

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS PARCHE CODE # 14

LOCATION & SPECIES	NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
64 RATS	50	5	1	-	6	3	6	1	1	1	—	—	—	—	—	—	8	18

TABLE 5

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE- 1 July 1946 USS FALLON CODE # 12

LOCATION & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
43	GOATS	3	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	0
	PIGS	3	-	-	1	-	-	1	-	-	-	-	—	—	—	—	—	—	1
	RATS	110	5	11	1	2	3	2	2	-	-	1	—	—	—	—	—	62	21
09	GOATS	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	1	-	-	2	-	-	-	-	-	-	—	—	—	—	—	—	7
04	GOATS	5	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	2	-	1	1	2	-	1	-	-	1	—	—	—	—	—	—	2
31	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	2
	RATS	10	-	-	-	1	1	-	-	1	-	-	—	—	—	—	—	1	6
53	PIGS	3	-	-	-	1	-	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	-	-	-	-	-	-	1	-	-	-	—	—	—	—	—	3	6
51	PIGS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
	RATS	10	-	-	-	3	-	-	-	-	1	-	—	—	—	—	—	—	6
63	RATS	50	40	7	2	-	-	-	-	-	-	-	—	—	—	—	—	—	1

TABLE 6

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS PENNSYLVANIA CODE # 21

LOCATIONS & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
03	GOATS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	2	1
	PIGS																		
	RATS	10	-	-	-	-	2	-	-	1	1	-	—	—	—	—	—	1	5
04	GOATS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	—	3
	RATS	10	-	5	-	2	-	-	-	-	-	-	—	—	—	—	—	1	2
11	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	—	3
	RATS	10	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	9
21	GOATS	2	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	-	-	-	-	-	-	1	-	-	-	—	—	—	—	—	—	9
24	GOATS	2	-	-	-	-	-	-	-	-	1	-	—	—	—	—	—	—	1
	RATS	10	-	-	1	1	1	-	1	-	-	-	—	—	—	—	—	—	6
33	PIGS	3	-	-	-	1	-	-	-	-	-	-	—	—	—	—	—	—	2
	RATS	10	-	-	-	-	-	-	-	-	-	1	—	—	—	—	—	—	9
35	PIGS	3	-	-	1	-	-	-	-	1	-	-	—	—	—	—	—	—	1
	RATS	10	-	-	1	-	-	-	-	3	-	1	—	—	—	—	—	—	6
42	GOATS	3	-	-	-	-	-	-	-	1	-	-	—	—	—	—	—	1	1
	RATS	110	-	6	2	2	5	3	4	-	-	-	—	—	—	—	—	57	30

TABLE 7

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS CATRON CODE # 13

LOCATION & SPECIES	NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
42 GOATS	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	0
PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	2
RATS	10	-	-	1	-	-	1	1	-	-	-	—	—	—	—	—	1	6
09 GOATS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	2
RATS	10	-	-	-	-	-	-	-	1	-	-	—	—	—	—	1	1	7
04 GOATS	5	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	0	5
RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
31 PIGS	3	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0
RATS	10	-	-	-	-	-	-	2	-	-	—	—	—	—	—	—	—	8
51 PIGS	3	-	-	-	1	-	-	-	-	-	-	—	—	—	—	—	1	1
RATS	10	-	-	-	-	-	-	-	1	-	-	—	—	—	—	—	1	8
53 PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	2
RATS	10	-	-	-	-	-	-	1	1	-	-	—	—	—	—	—	—	8
63 RATS	50	9	-	1	1	2	-	1	-	1	2	—	—	—	—	—	1	32

TABLE 8

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS WAINWRIGHT CODE # 41

LOCATION & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
00	GOATS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	PIGS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	RATS	90 CP	5	-	-	2	2	5	-	1	-	-	-	-	-	-	-	75	0
06	GOATS	3	-	-	-	-	-	1	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	1	-	1	-	1	-	1	-	-	-	—	—	—	—	—	—	6
34	PIGS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
	RATS	10	1	-	-	-	1	-	-	-	-	-	—	—	—	—	—	2	6
42	GOATS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	2	1
	RATS	10	2	-	-	-	-	-	-	-	-	-	—	—	—	—	—	—	8

TABLE 9

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS BRACKEN CODE # 22

LOCATION & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
43	GOATS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
	PIGS	3	-	-	1	-	-	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	-	-	-	-	1	-	-	-	1	-	—	—	—	—	—	2	6
04	GOATS	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
09	GOATS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
	RATS	10	-	-	-	-	-	-	-	-	-	1	—	—	—	—	—	—	9
31	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	2	1
	RATS	10	-	-	-	-	-	1	-	-	1	-	—	—	—	—	—	2	6
51	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	2	1
	RATS	10	-	-	-	1	-	1	-	-	1	1	—	—	—	—	—	1	5
53	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	2
	RATS	10	-	-	-	-	-	1	2	1	-	-	—	—	—	—	—	—	6
63	RATS	100	8	1	5	4	3	5	10	5	4	-	—	—	—	—	—	3	52

TABLE 10

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS LST 661 CODE # 24

LOCATION & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
02	GOATS	3	-	-	-	-	-	-	-	1	-	-	—	—	—	—	—	1	1
	PIGS	-	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	-	-
	RATS	10	7	-	-	-	-	-	-	-	1	-	—	—	—	—	—	-	2
27	GOATS	3	-	-	-	-	-	-	-	1	-	-	—	—	—	—	—	1	1
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
37	PIGS	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
42	GOATS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	-	3
	RATS	10	-	-	-	-	1	-	1	-	-	-	—	—	—	—	—	1	7
51	PIGS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
	RATS	10	-	-	-	-	2	-	-	-	-	-	—	—	—	—	—	-	8
63	RATS	100	2	2	1	1	4	3	2	2	4	2	—	—	—	—	—	8	69

TABLE 11

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS LCI 327 CODE # 34

LOCATION & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
02	GOATS	2	-	-	-	-	-	-	-	-	-	-							2
	PIGS																		
	RATS	10	-	-	-	-	-	-	-	-	1	-						4	5
25	GOATS	4	-	-	-	-	-	-	-	-	-	-							4
	RATS	10	-	-	-	2	-	-	1	-	-	-						1	6
34	GOATS	3	-	-	-	-	-	-	-	-	-	-							3
	RATS	10	-	-	-	-	-	-	1	1	-	1							7
42	GOATS	2	-	-	-	-	-	-	-	1	-	-							1
	RATS	10	-	-	1	-	1	1	-	-	1	-	-	-	-	-	-	6	0

TABLE 12

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS FILLMORE CODE # 23

LOCATION & SPECIES	NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
43 GOATS	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	0
PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	2	1
RATS	120*	-	9	-	1	1	1	-	1	-	1	—	—	—	—	—	88	18
04 GOATS	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0
RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
09 GOATS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
31 PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	2
RATS	5	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-,	0
51 PIGS	3	-	1	-	-	-	-	-	-	-	-	—	—	—	—	—	—	2
RATS	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
53 PIGS	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	0
RATS	10	-	3	-	-	-	-	-	-	-	-	—	—	—	—	1	6	0
63 RATS	90	3	5	4	2	2	2	7	2	2	2	—	—	—	—	—	36	23

*Ten rats erroneously placed in Pilot House as per contact report. Numbers unknown. These rats should have beer exposed; 5 each in location 31 and 51.

TABLE 13

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS LCI 329 CODE # 43

LOCATION & SPECIES	NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
02 GOATS	2	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	—	2
PIGS		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RATS	10	-	-	-	-	-	2	-	-	-	-	—	—	—	—	—	1	7
25 GOATS	4	-	-	-	-	-	-	1	-	-	-	—	—	—	—	—	—	3
RATS	10	-	3	-	1	-	-	-	-	-	-	—	—	—	—	1	—	5
34 GOATS	3	-	-	-	-	-	1	-	-	-	-	—	—	—	—	—	—	2
RATS	10	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	9
42 GOATS	2	-	-	-	-	-	-	1	-	-	-	—	—	—	—	—	—	1
RATS	10	-	-	-	-	-	2	-	1	-	-	—	—	—	—	—	—	7

TABLE 14

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS BLADEN CODE # 31

LOCATION & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
43	GOATS	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	0
	PIGS	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	0
	RATS	10	-	-	-	-	-	-	1	-	1	1	—	—	—	—	—	—	7
04	GOATS	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
09	GOATS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
	RATS	10	-	-	1	-	-	-	-	2	-	-	—	—	—	—	—	—	7
31	PIGS	3	-	-	-	-	1	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	1	-	-	1	1	-	-	-	-	-	—	—	—	—	—	—	7
51	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	2	1
	RATS	10	-	-	-	-	1	-	-	1	-	-	—	—	—	—	—	—	8
53	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	2	1
	RATS	10	1	-	-	1	-	-	-	2	-	-	—	—	—	—	—	—	6
63	RATS	100	-	-	7	2	3	4	2	1	2	7	—	—	—	—	—	23	49

TABLE 15

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS GENEVA CODE # 33

LOCATION & SPECIES	NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
43 GOATS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
PIGS	3	-	-	-	-	-	-	-	-	-	-						1	2
RATS	10	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0
04 GOATS	5	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	3	0
RATS	10	-	-	-	1	-	-	-	-	-	-					1		8
09 GOATS	3	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	0
RATS	10	-	-	-	-	-	-	-	-	-	-							10
31 PIGS	3	-	-	-	-	-	-	-	-	-	-						2	1
RATS	10	-	-	-	-	-	1	-	-	-	1							7
51 PIGS	3	-	-	-	-	-	-	-	-	-	-						2	1
RATS	10	-	-	-	-	-	-	-	-	-	-						1	9
53 PIGS	3	-	-	1	-	-	-	-	-	-	-							2
RATS	10	-	-	1	-	-	1	-	-	-	-							8
63 RATS	100	-	-	-	6	4	3	2	1	2	1					1	20	60

TABLE 16

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS NIAGARA CODE # 42

LOCATION & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
43	GOATS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	2	1
	PIGS	3	-	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	2
	RATS	10	-	1	1	2	2	-	-	-	-	-	—	—	—	—	—	—	4
04	GOATS	9*	1	-	-	-	-	-	-	-	1	-	—	—	—	—	—	1	2
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
09	GOATS	3	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	0
	RATS	10	-	-	-	-	-	-	-	-	1	-	—	—	—	—	—	—	9
31	PIGS	3	1	-	-	-	-	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	1	2	-	-	-	-	-	-	-	-	—	—	—	—	—	—	7
51	PIGS	3	-	-	1	-	-	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	-	2	1	-	-	-	1	-	1	-	—	—	—	—	—	—	5
53	PIGS	3	-	1	-	-	-	-	-	-	-	-	—	—	—	—	—	1	1
	RATS	10	-	-	-	-	1	-	-	-	-	1	—	—	—	—	—	—	8
63	RATS	100	-	-	5	6	3	7	3	7	1	1	—	—	—	—	—	24	43

*4 - Cornell

TABLE 17

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS LCT - 705 CODE # 53

LOCATION & SPECIES	NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
00 GOATS	3	-	-	-	-	-	-	-	-	-	-						1	2
PIGS																		
RATS	10	-	-	1	1	-	1	-	-	-	-						2	5
37 PIGS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
RATS	10	-	-	-	-	-	-	-	-	-	-						1	9
43 GOATS	3	-	-	-	-	-	-	-	-	-	-						1	2
RATS	10	-	-	-	-	-	-	-	-	2	1						4	3
00 RATS	90 C.P.	63	-	-	-	2	-	-	-	-	-	-	-	-	-	11	14	0

TABLE 18

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS LST 133 CODE # 44

LOCATIONS & SPECIES		NO. PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
O2	GOATS	3	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	1	0
	PIGS																		
	RATS	10	2	-	-	2	-	1	-	1	-	-	-	-	-	-	-	4	0
27	GOATS	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	0
	RATS	10	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	9	0
37	GOATS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
	RATS	10	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	7	0
42	GOATS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
	RATS	10	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	6	0
51	PIGS	3	-	-	1	-	-	-	-	-	-	-						1	1
	RATS	10	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	9	0
63	RATS	100	-	-	6	3	5	4	4	-	-	-						73	5

TABLE 19

TABLE OF ANIMAL DEATHS AS RELATED TO TIME AND SHEILDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 July 1946 USS SAKAWA CODE # 02

LOCATION & SPECIES		NO. PEACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
03	GOATS	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	PIGS																		
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
22	GOATS	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
24	GOATS	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
26	GOATS	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
33	PIGS	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
35	PIGS	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
36	PIGS	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
42	GOATS	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	RATS	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0

a. TABLES OF ANIMAL DEATHS AS RELATED TO TIME AND SHIELDING AFFORDED BY TEST LOCATION

TEST ABLE - 1 JULY 1946

LOCATION & SPECIES	NUMBER PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
TABLE 20																		
USS BUTTE - CODE No. 32																		
00 RATS	90 CP	19	--	--	1	--	1	4	--	--	--	--	--	--	--	34	31	0
TABLE 21																		
USS MAYRANT - CODE No. 51																		
00 RATS	90 CP	3	--	--	1	5	1	--	--	--	--	--	--	--	--	41	39	0
TABLE 22																		
USS LCT 1013 - CODE No. 52																		
00 RATS	90 CP	39	--	--	--	--	2	--	--	--	--	--	--	--	--	18	31	0

TABLES OF ANIMAL DEATHS AS RELATED TO TIME AND SHIELDING AFFORDED BY TEST LOCATION

TEST BAKER - 25 JULY 1946

LOCATION AND SPECIES	NUMBER PLACED	TARGET DEATHS	1st WK.	2-4 WK.	2nd MO.	3rd MO.	4th MO.	5th MO.	6th MO.	7th MO.	8th MO.	9th MO.	10th MO.	11th MO.	12th MO.	DEATH DATE UNKNOWN	KILLED FOR STUDY	REMAINING ALIVE
TABLE 23																		
USS GASCONADE - Code No. 05																		
20 PIGS	10	6	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
RATS	50	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
TABLE 24																		
USS BRISCOE - Code No. 06																		
20 RATS	49		13	20	1	1	-	-	-	-	-	-	-	-	-	-	-	14
TABLE 25																		
USS CATRON - Code No. 13																		
20 PIGS	10	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	0
RATS	50	-	9	-	7	2	2	-	4	-	3	-	-	-	-	-	1	22
TABLE 26																		
USS BRACKEN - Code No. 22																		
20 RATS	50	20	1	1	-	-	-	-	-	-	-	-	-	-	-	-	10	18