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ARMY SERVICE FORCES
UNITED STATES ENGINEER OFFICE
MANHATTAN DISTRICT
OAK RIDGE, TENNESSEE

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11 January 1946.

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NO. 1 OF 5 COPIES, SERIES A

Subject: Blast Information.

To: Capt. Hugh L. Dwyer, P. O. Box 2610, Washington, D.C.

1. The following information is being forwarded to you at the request of Col. S. L. Warren. This information was compiled from the incident on 6-10 May 1945, and experiments performed by Dr. Kemplemann and Capt. Nolan:

a. "The mice were autopsied by Captain Nolan and this officer, with the findings of typical blast shock in graded stages closely approximating the forces estimated for the various distances at which they were located. The surprising thing was to find at the furthest location, 1960 ft., a fatal shock from blast at an estimated 0.75 lbs. (actual 1.5 lbs.).

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b. Blast.

(1) English and other data indicate that for man the lethal peak pressures vary between 340 to 470 lbs/sq. in. with a single high figure of 575 lbs/sq. in. Eardrum rupture is reported over the range between 4 and 15 lbs/sq. in. It is the opinion of this officer that this is too high because of freak accidents and because those estimates are made upon the basis of airline and estimated distances and estimated pressures from casualties in buildings and streets, etc., where conditions were not suitable for direct blast effects. The blast waves were seriously modified by reflection and interferences of various sorts, etc., which diminished their intensity tremendously.

(2) Published data on animals experiments are in general of no value except for one report on mice (British N.C.R. report) which gives a 50% mortality value at 45 lbs/sq. in. These experiments while nicely worked out were done with the animals in cages. The protective effects of the cage wall (wire mesh) were not taken into consideration.

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Similarly, experiments by the U.S. Navy (Medical) were performed by hanging cats in bags, which protected the cats from the lethal effects of the blast unless the bags were hung closely enough to be burnt by the flame of the explosion. In other experiments by many workers, most of the animals were put so close as to be killed by missiles (gravel, etc.). In general, no pressures were actually measured.

(3) Experiments were done at Y by Drs. Hempelmann and Capt. Nolan with mice suspended on wire by battery clips, holding to the hair and skin of the mid-back, thus suspending painlessly the mouse free of obstruction in the air. On the first test, the mice were killed with typical signs of blast effects on the lungs at estimated peak pressures as low as 2.8 lbs/sq. in. at a distance of 115 feet from 175 lbs. of TNT equivalent. Those subjected to pressures higher than 4.1 lbs/sq. in. were blown off the clips and killed by the blast of missiles.

(4) Experiments done at Muriel indicated that a pressure of 1.5 lbs/sq. in. (at 1960 ft.) were near the 50% mortality level. This is still well above the 50% value since all four of the test mice put here died with typical lesions of the lung of the same extent. All those mice closer to the blast had proportionately more extensive and more severe lesions.

(5) If these findings have any relative or comparative value, then a large reduction probably of the order of 1/20 or more must be made in the figures for human lethal effects. This would reduce the average of the reported values (approximately 400 lbs/sq. in.) down to the order of 20 lbs/sq. in. if these considerations are valid.

(6) Observers during Test I stood out in the open at six miles during the Test I and felt a mild, sharp impact from the blast wave. The calculated pressure here was 0.1 lbs/sq. in. The actual pressure measured at this point is not known to this officer. A mild ground shock was also reported. This would seem to be a safe pressure to use as a guide for limiting the distance of personnel from Test II.

(7) Peak wave pressures do not follow a constant law in their propagation outward from the source, but change inversely by the square, the 2/3 power and finally directly with the distance from the source as they proceed. Very high intensities perhaps act differently from the ordinary conceptions gained from lower intensities.

(8) It is the belief of this officer that peak pressures is the main factor in the lethal lung blast effect and that the

overall duration is unimportant (within certain limits) provided that the ascending pressure wave is steep. The negative pressure wave is probably responsible for rupture of intestines when this occurs. The animal (and probably man also) is killed by peak pressures, however, when the negative pressure is insufficient to harm the intestinal tract.

(9) Apparatus for producing blast waves of various types and duration has been made available at Y where-by a mortality curve can be worked out quickly for mice under precise conditions and where the influence of duration of the wave, and the protection afforded by mesh of various sorts and dimensions and cloth, etc., can be observed. Captain Nolan and Dr. Hempelmann plan to do this within the next few weeks as time permits.

(10) The treatment of a case with blast injury is extremely limited. The injury, apparently from the impact of the rib cage on the lungs, results in bleeding and the patient drowns in his own blood or oozing plasma and edema fluid. Pure oxygen, preferably administered under a moderate pressure by a mask or nasal tube, may assist the patient in maintaining his oxygen needs until the bleeding, etc., subsides. This should be administered wherever the patient may be found.

(11) There are a lot of contraindications: The patient must not be moved until the acute stage is over; artificial respiration makes the situation worse by increasing bleeding; no sedative may be given because it diminishes the respiratory impulse. No stimulants may be used because they increase the heart rate (i.e. blood flow through the lungs.) The patient should be kept comfortably warm with blankets, etc., if necessary, given oxygen and otherwise let alone. Mixtures of O₂CO₂ must not be used because of the hyperventilation which may ensue."

2. It is requested that the two enclosures be returned to this office as soon as it is convenient since they are the only copies for our files.

For the District Engineer:



ROBERT J. BUETTNER,
Captain, M.A.C.
Assistant.

2 Incls.:
1 & 2 Maps