INDEX NO. X 28-1

MISCELLANEOUS TARGETS

ATOMIC BOMBS, HIROSHIMA AND NAGASAKI

ARTICLE 1

MEDICAL EFFECTS

U.S. NAVAL TECHNICAL MISSION TO JAPAN

N-1391 DECLASSIFIED 274500

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U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA

15 December 1945

[redacted]

From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Atomic Bombs, Nagasaki and Hiroshima.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Article 1 of the report covering Target X-28 of Fascicle X-1 of reference (a), dealing with medical effects, is submitted herewith.

2. The investigation of the target and the target report were accomplished by Comdr. Shields Warren (MC), USNR, assisted by Lt. Comdr. N. Pace (HC), USNR, and Lieut. R.E. Smith (HC), USNR, and with the assistance of Lt. Col. I.M. Sinclair, AUS, Lt.(jg) H.F. Harsberger, USNR, and Lt.(jg) F.G. McKnight, USNR, as interpreters and translators.

C. G. GRIMES
Captain, USN

[redacted]

DECLASSIFIED

27 AUG 1946

Reg # 111211

ATOMIC BOMBS, HIROSHIMA AND NAGASAKI

ARTICLE 1

MEDICAL EFFECTS

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE X-1, TARGET X-28, ARTICLE 1

DECEMBER 1945

DECLASSIFIED

U.S. NAVAL TECHNICAL MISSION TO JAPAN

TABLE OF CONTENTS

LIST OF ENCLOSURES

LIST OF ILLUSTRATIONS

* * * * *

REFERENCES

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The explosion was of incredible intensity and of extremely short initial duration (perhaps one micro-second) with a fire-ball lasting up to one second. Nearly the whole electro-magnetic spectrum was apparently emitted, as well as a neutron cloud. Gamma radiation was produced by neutron bombardment of atmospheric nitrogen.

The day was clear, hot and dry, with a light easterly wind, but soon after the explosion showers occurred in the western portions of the city.

The account of Father Siemes is so accurate and graphic that it is given verbatim and will be the only lay account presented for this city.

* * * * *

Eyewitness Account of Father Siemes
(Verbatim)

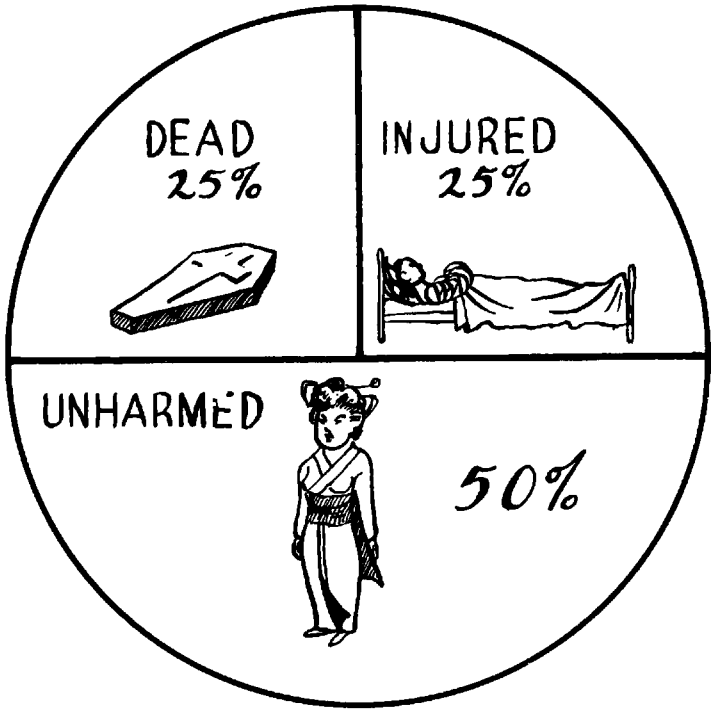
Up to August 6th, occasional bombs, which did no great damage, had fallen on HIROSHIMA. Many cities roundabout, one after the other, were destroyed, but HIROSHIMA itself remained protected. There were almost daily observation planes over the city but none of them dropped a bomb. The citizens wondered why they alone had remained undisturbed for so long a time. There were fantastic rumors that the enemy had something special in mind for this city, but no one dreamed that the end would come in such a fashion as on the morning of August 6th.

August 6th began in a bright, clear, summer morning. About seven o'clock, there was an air raid alarm which we had heard almost every day and a few planes appeared over the city. No one paid any attention and at about eight o'clock, the all-clear was sounded. I am sitting in my room at the Novitiate of the Society of Jesus in NAGATSUKA; during the past half year, the philosophical and theological section of our Mission had been evacuated to this place from TOKYO. The Novitiate is situated approximately two kilometers from HIROSHIMA, half-way up the sides of a broad valley which stretches from the town at sea level into the mountainous hinterland, and through which courses a river. From my window, I have a wonderful view down the valley to the city. Suddenly - the time is approximately 8:14 - the whole valley is filled by a garish light which resembles the magnesium light used in photography, and I am conscious of a wave of heat. I jump to the window to find out the cause of this remarkable phenomenon, but I see nothing more than that brilliant yellow light. As I make for the door, it doesn't occur to me that the light might have something to do with enemy planes. On the way from the window, I hear a moderately loud explosion which seems to come from a distance and, at the same time, the windows are broken in with a loud crash. There has been an interval of perhaps 10 seconds since the flash of light. I am sprayed by fragments of glass. The entire window frame has been forced into the room. I realize now that a bomb has burst and I am under the impression that it exploded directly over our house or in the immediate vicinity. I am bleeding from cuts about the hands and head. I attempt to get out of the door. It has been forced outwards by the air pressure and has become jammed. I force an opening in the door by means of repeated blows with my hands and feet and come to a broad hallway from which open the various rooms. Everything is in a state of confusion. All windows are broken and all the doors are forced inwards. The book-shelves in the hallway have tumbled down. I do not note a second explosion and the fliers seem to have gone on. Most of my colleagues have been injured by fragments of glass. A few are bleeding but none has been seriously injured. All of us have been fortunate since it is now apparent that the wall of my room opposite the window has been lacerated by long fragments of glass. We proceed to the front of the house to see where the bomb has landed. There is no evidence, however, of a bomb crater; but the southeast section of the house is very severely damaged. Not a door nor a window remains. The blast of air had penetrated the entire house from the southeast, but the house still stands. It is constructed in the Japanese style with a

GRAPH I

DISTRIBUTION OF CASUALTIES

HIROSHIMA



Steel frame-work towers and trolley poles close to the hypocenter stood better than those somewhat more distant, which received more lateral force.

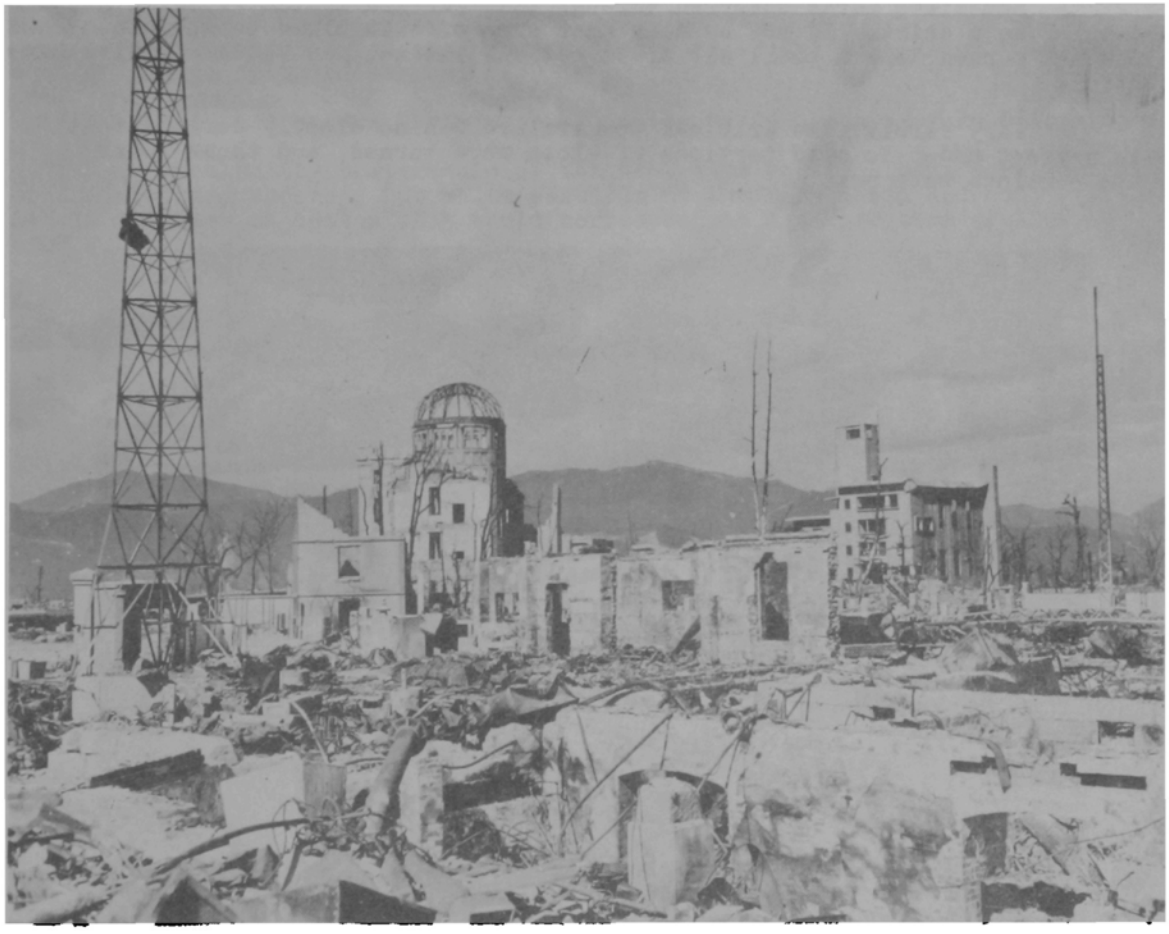


Figure 4

VIEW NEAR HYPOCENTER

Smoke stacks stood throughout the area. The Japanese houses, which had been one or two-story structures of wood with tile roofs, were reduced to ashes and broken tile. Foundations and remnants of metal objects, such as bicycles, sewing machines, or pipes showed amid the general waste. Even at the time of our visit in October, human bones were easily found amid the debris. At the periphery, the wooden structures were crushed, pushed over, or distorted, but were not burned.

Practically all persons questioned who had been in the region felt the wave of heat mentioned by Father Siemes in his account. Most of those exposed within four kilometers received flash burns on exposed skin. Lt. Col. Averill Liebow, MC, AUS, has made a careful study of these flash burns, and pointed out numerous instances where a lock of hair, light clothing, the protection afforded by projection of ear, nose or chin served amply to prevent the development of flash burn.

Sometimes burns occurred through that portion of the clothing that was thin, as a shirt. If so, usually that area of skin close to the cloth alone was burned, and a small air space between the two was enough to give protection.

Very rarely, the critical temperature was so clearly defined that skin regions under colored portions of cloth were burned, and those under white portions were not.

Figure 5

HEALING SECOND DEGREE FLASH BURNS DUE TO ATOMIC BOMB

The margins of the burns were sharply defined. If they had not been infected, they healed fairly well.

The hair was sometimes burned off, but usually was intact or had regenerated. Sometimes the sweat glands had been destroyed.

The margins of the healed burns were not only sharply defined, but often accentuated by a narrow zone of pigment loss in the adjacent normal skin, with denser pigmentation over the edge of the scar, fading off centrally.

Some showed keloid formation, but not to a greater extent than in burns due to other causes.

Secondary flame burns were usually deeper than the flash burns, and of less extent. These burns or their scars were more rare than flash burns, as those who received them were usually in those regions where most of the people had been killed.

Most of the survivors, as we saw them in October, 1945, showed flash burns of varying extent and/or epilation. A few had hemorrhagic tendencies due to bone marrow injury, and some were found to have anemia, with or without diminution of white blood corpuscles.

Most flash burns when we saw them were healed or healing, and had been of second or third degree.

The more severe burns were producing various contracture deformities.

Rarely, the temperature of the heat wave was such that dark portions of the clothing charred, but white portions of the same cloth did not. (Figure 6) In the case of cotton this would correspond to a temperature of 400° to 450° F.

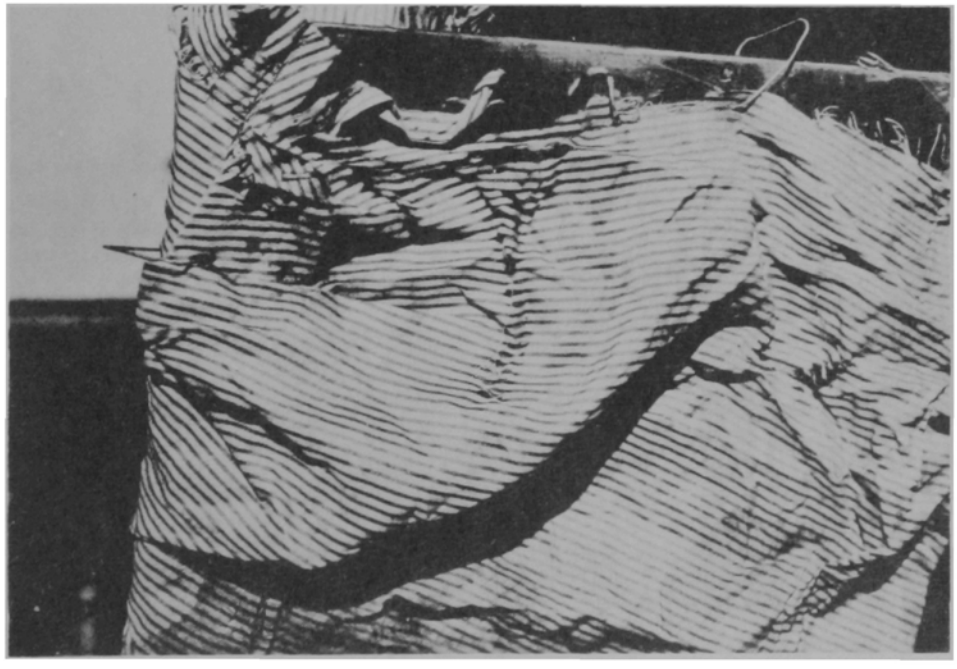


Figure 6

CHARRED

Dark green stripes charred over shoulder nearest bomb explosion; white stripes not charred.

Telephone poles were charred for a considerable distance. Prof. S. IMAMURA of Kyoto Imperial University states that the wood of Cryptomeria Japonica, of which the poles are made, when seasoned, carbonizes at 200°C and ignites at 270°C. We assume this to be expressed in terms of "effective heat."

By "effective heat" we mean that which when maintained for several seconds to a minute will produce a given effect. Even terrific heat applied for an instant, as in the case of the bomb, does not have time for effective transfer of energy.

It is probable that most fires in the bombed area originated from stoves, electric short-circuits and the like, though this is a matter of conjecture. Some flame burns resulted during the conflagration.

The height and location of the detonating bomb was determined with a high degree of accuracy by the study of shadow silhouettes it produced on various objects by its heat. Japanese investigators had located it approximately within a few days after the explosion.

Sharp lines of "shadow" left where one granite block protected portions of another, where cross-arms or spikes left their shadowing effect on still erect poles, where bridge railings cast "shadows," and other types of "shadows," accurately indicate the center. Examples are shown in Figures 7 and 8.

Lines of blast force, indicated by wrecked buildings, uprooted trees, poles broken or leaning, point radially to the center.

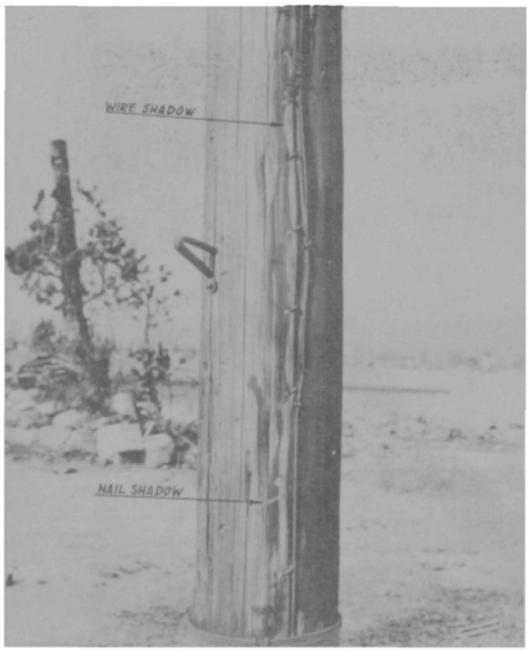


Figure 7
"SHADOWING" EFFECT OF WIRE ON TELEPHONE POLE
(Note sharp line of shielding by nail near bottom.)

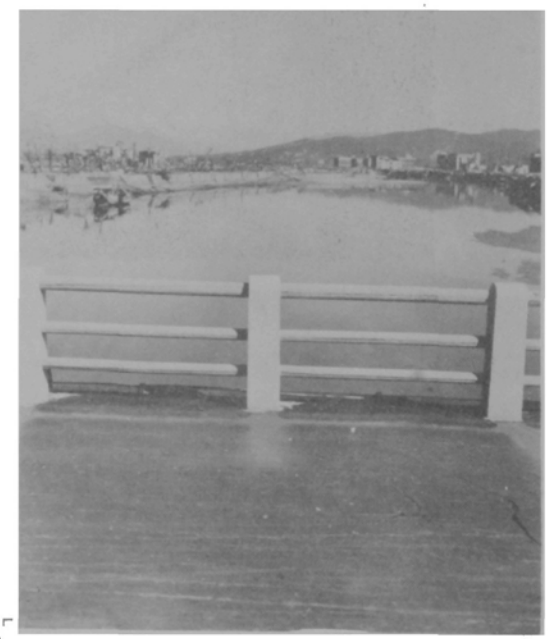


Figure 8
"SHADOW" OF BRIDGE POST AND RAILING ON ASPHALT ROADWAY

The instantaneous character of the explosion is shown by Figure 9 where the leaf sheltered the pole from charring before the blast displaced it. Figure 10 shows where a man was walking, as well as a man and the cart he was pulling. They were pictured in shadow on the asphalt by the heat rays before they were swept away.

Figure 9

"SHADOW" OF LEAF ON CHARRED TELEGRAPH POLE

Figure 10

"SHADOW" OF MAN WALKING (foreground) and (just beyond) that of cart and man pulling it

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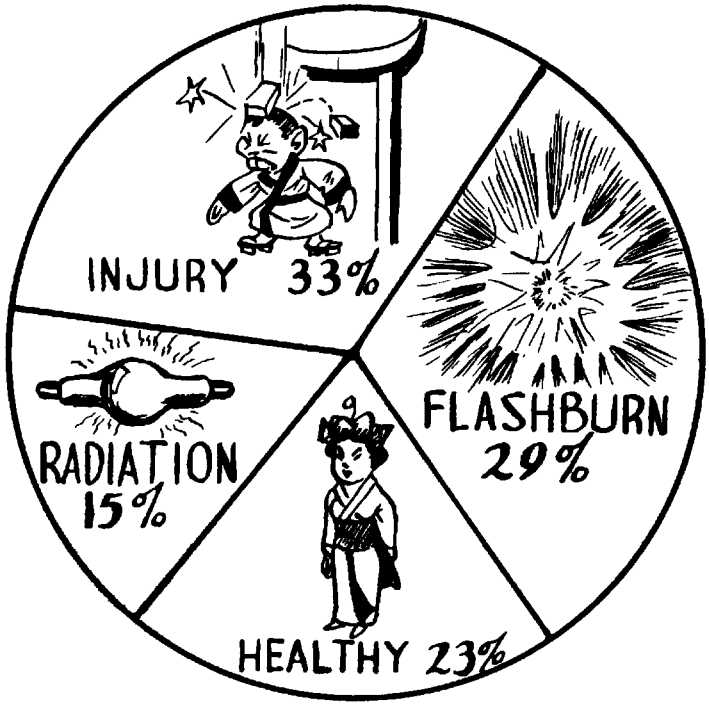
GRAPH 2

EFFECT UPON SURVIVORS

(Sample of 4030)

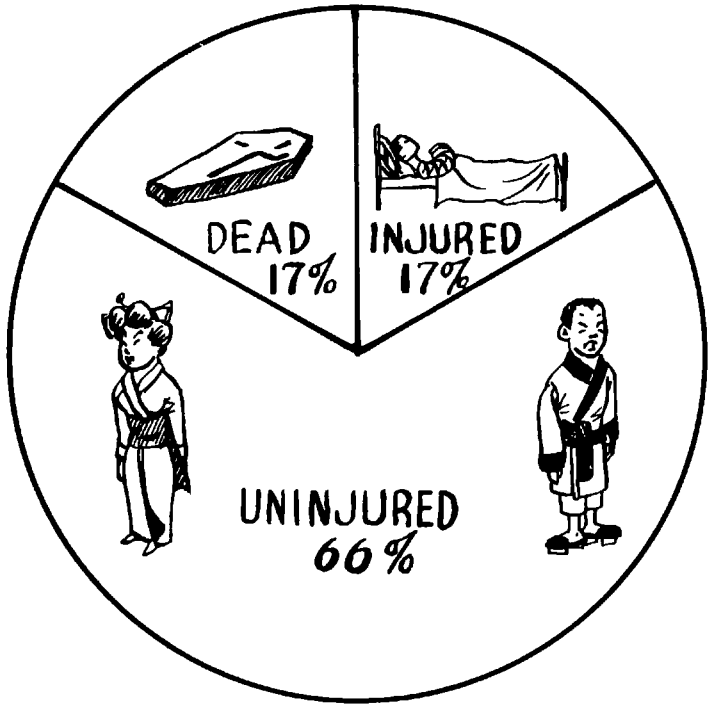
HIROSHIMA



GRAPH 4

EFFECTS UPON TOTAL POPULATION

NAGASKI



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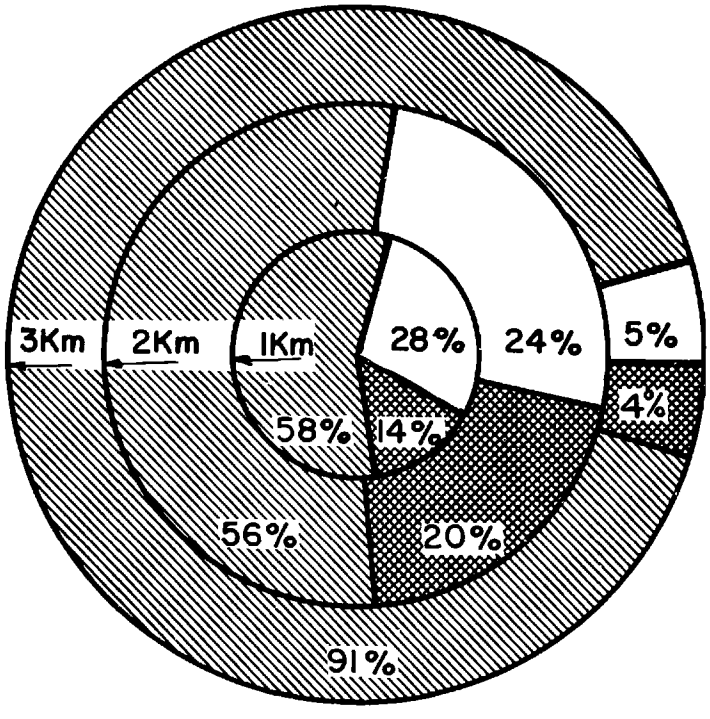
GRAPH 5

EFFECT UPON PERSONS SHELTERED BY CONCRETE BUILINGS

(Sample on 2182 survivors)

NAGASAKI



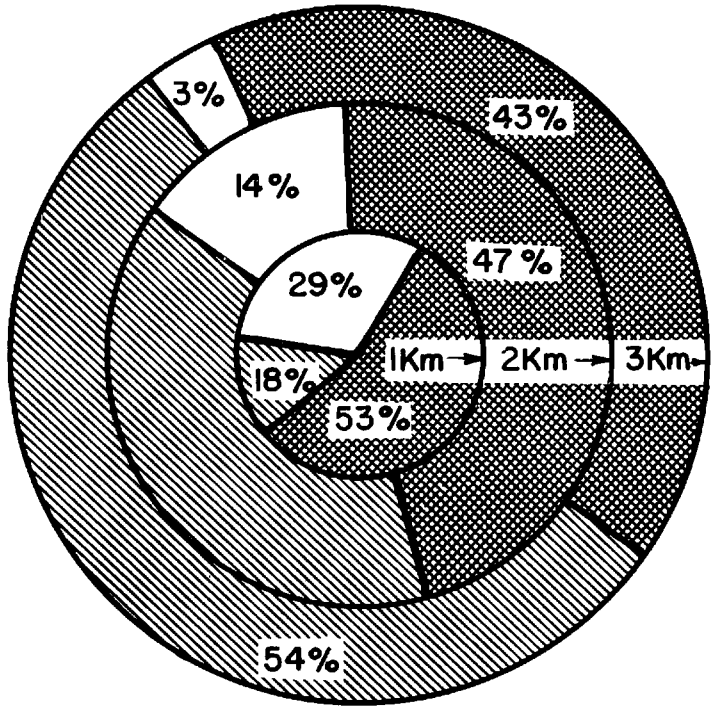
BURN
OTHER INJURY
HEALTHY

GRAPH 6

EFFECT UPON PERSONS IN OPEN

(Sample of 2182 survivors)

NAGASAKI



BURN
OTHER INJURY
NORMAL

Casualty figures have been difficult to determine. No sound figures of population exist. Lt. Col. LeRoy, Wing Comdr. Bronowski, RAF, associated with the U.S. Strategic Bombing Survey, and Comdr. Warren, (MC), USNR, attempted to assemble these figures, which are believed to be the most accurate available.

POPULATION OF NAGASAKI

	Men	Women	Total
Secret Census, 19 Feb. 1944	137,015	133,098	270,133
Rice Rationing, May 1945 with added military and factory personnel			207,806 260,000+
Census, 1 Nov. 1945*	69,789	72,959	142,748
Rice Rationing, Computed for 1 Nov. 1945			143,617

* See Enclosure (E).

Police permits to leave the city had been granted to 29,313 persons.

The prefectural report of 1 Sept. 1945, gives 23,359 killed, 40,992 injured and 1927 missing.

On the basis of these reports and figures and on our own estimation of casualties, we believe the best approximate figures are: killed 45,000; injured 45,000. See Graph 4.

When it is remembered that only about one-third of the area of the city was in the effective zone of the blast, the lethal power of the bomb can be well appreciated.

In our casualty survey of Nagasaki survivors, 2182 random cases were selected from the 5000 total. These included all cases in the Shinkozen and Omura hospitals. They were grouped in zones of equal distance from the hypocenter, ranging from one to four or more kilometers, and were also classified according to whether they were within concrete, wood, or steel buildings, or in the open. The figures for those in concrete buildings and those in the open are shown in Graphs 5 and 6.

Graph 5 does not mean that 58 percent of those who were in the concrete buildings within a kilometer of the hypocenter survived. Seventy five percent of those in the concrete hospital buildings were killed. But of those who did survive, it means 58 percent suffered no harm, as against 18 percent of those who had been in the open and survived (Graph 6). Probably these 18 percent unharmed were sheltered from the center of explosion by buildings or tile roofs, though technically in the open.

There were three risks to those in concrete buildings. In order of magnitude these were:

1. Fire (most Japanese buildings have wooden trim).
2. Secondary (scattered) radiation.
3. Trauma from glass and other flying debris.

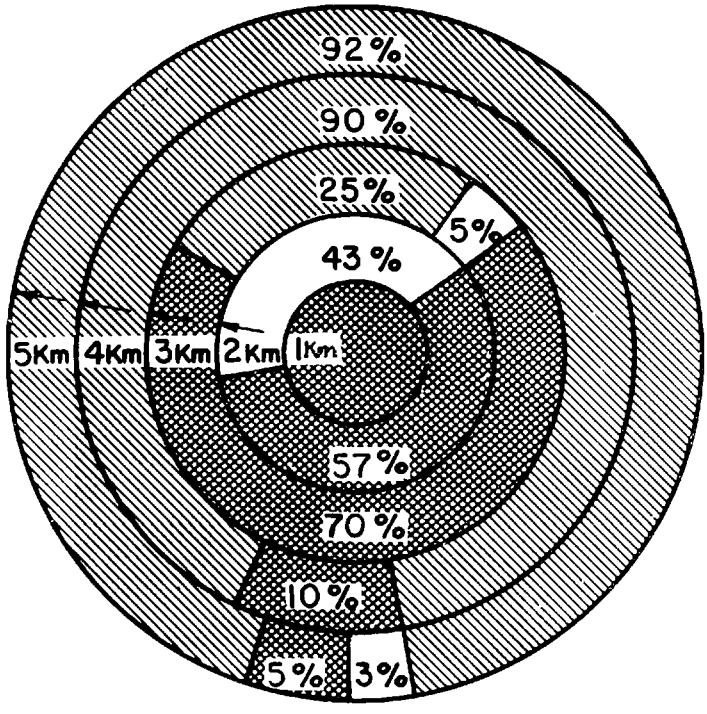
By the time the three kilometer zone was reached, distance alone was a protecting factor, since gamma radiation and infra-red rays both follow the inverse square law. Thus, even in the open, 54 percent of the survivors suffered no harm, and 91 percent of those in concrete buildings were uninjured.

GRAPH 8

EFFECTS ON CHILDBIRTH

9 AUGUST TO 15 NOVEMBER 1945

NAGASAKI



MISSCARRIAGE
PREMATURE
NORMAL

Effect on Child-Birth:

Graph 8 demonstrates in startling fashion the disastrous effect of the atomic bomb on pregnancy. These figures are not complete, as it was not possible to contact all obstetricians and midwives. However, it is believed that they are representative. No vital statistics worthy of the name are kept, so no check can be made by this means. Since 9 August 1945, 182 cases had sufficiently accurate records for study. Within two kilometers of the hypocenter there were no normal births. Within one kilometer of the hypocenter, all mothers died. Between one and two kilometers of the hypocenter, half the mothers died.

Outside these zones, between two and three kilometers, a few normal births occurred, and beyond three kilometers the results paralleled the control group.

These miscarriages and premature births were almost all due to hemorrhage into the placenta because of delayed clotting power of the mother's blood.

Effect on the Eyes:

Retinitis occurred in a number of patients. Flame hemorrhages near the macula were most frequent. A few preretina hemorrhages appeared. The hemorrhages resorbed, if they were small, leaving non-pigmented foci in their wake. Rarely was vision seriously impaired.

Lens changes were not noted. Keratitis did not appear as a sequel to the radiation.

Effect on wound healing and growth:

Traumatic injuries and fractures apparently healed about as would be expected under usual conditions.

In children, no evidence of delayed bone growth due to epiphyseal or other radiation injury was seen.

Malnutrition and poor hygiene, both very prevalent in those injured by the bombs, would account for any changes in growth rate that may appear. Careful follow-up of NAGASAKI and HIROSHIMA patients will be needed for some time to check on this point. The period of observation available is too short for a final statement.

Due to wartime privations, the average Japanese child is one centimeter shorter and one kilogram lighter than before the war.

Changes in Blood Chemistry:

1. Blood Proteins. The Japanese population exists on a relatively low margin of protein intake over protein requirement. Consequently, quite early after serious injury with poor or no care, one may see a drop in protein to a level of 5.2 or below with the development of nutritional edema. This nutritional edema clears up usually within a week after the patients are placed on an adequate diet. In the Omura Hospital, where the diet was adequate, nutritional edema and low blood protein levels were extremely rare. In the Shinkozen Hospital, where care and food for the patients was extremely poor, low protein and nutritional edema occurred in a fair number of cases. Most of these recovered within a few days when transferred to the Omura Hospital. A group of cases were studied from 14 to 78 days after the bombing at the Imperial University of Kyushu and it is believed that the determinations are well and carefully done.

During use in the field the counter was set at a distance of one meter above the ground by means of a support. Wherever possible the location of each point of measurement was accurately fixed on aerial photo mosaics of the area being surveyed. Adequate photo coverage was available for most of the NAGASAKI measurements. The survey comprised about 1000 individual measurements, 900 in the NAGASAKI area and 100 in the HIROSHIMA area. In addition, a number of earth samples were collected for further study in the United States.

In addition to the physical measurements, a brief evaluation of physiological effects of the residual radiation was made by obtaining case histories and blood studies on some 60 persons residing in the NAGASAKI area of activity, but who were not exposed to the bomb explosion.

Results:

The areas of residual activity at both NAGASAKI and HIROSHIMA were found to be of two types: (1) a well-defined, roughly radially, symmetrical area about the hypocenter of the explosion, and (2) a diffuse and generally larger area displaced some distance from the hypocenter. In the following the term "center" will denote the exact site of the bomb explosion in the air above the gound, and the term "hypocenter" will denote the point on the earth's surface directly beneath the center of the explosion. The geographical areas of residual activity about the hypocenters will be known as the NAGASAKI center area and HIROSHIMA center area, respectively. The geographical area of activity displaced from the hypocenter at NAGASAKI exhibited the highest radiation values near the Nishiyama Reservoir, 2.7 kilometers east of the hypocenter, and will be referred to as the NISHIYAMA area. The corresponding area at HIROSHIMA occurred at the village of TAKASU, 3.2 kilometers west of the hypocenter, and will be termed the TAKASU area.

The geographical distribution of the residual radioactivity at NAGASAKI and HIROSHIMA is shown in a series of four maps. Enclosure (J) shows the distribution of activity in the NAGASAKI center area, Enclosure (K) shows the distribution in the NAGASAKI center and NISHIYAMA areas, Enclosure (L) shows the extent of the activity in the NAGASAKI area, and Enclosure (M) shows the extent of the activity in the HIROSHIMA area. In addition, Table 1 gives a comparison of the size of the NAGASAKI and HIROSHIMA central areas.

Discussion:

It is evident from the map in Enclosure (J) that the residual activity about the hypocenter is roughly radially symmetrical. The departure from true symmetry can be explained in large part by the broken nature of the terrain in this area. It is believed that the elongated nature of the 50μ r/hr contour is in some measure due to the fact that a hill (on which the prison was located) is in the area. Likewise the smaller isolated 50μ r/hr contour occurred on the side of a hill to the southeast of the hypocenter.

There seems to be little doubt that this residual activity was induced from the bombardment of ground material by the neutron and gamma ray shower incident to the explosion. The apparent half-life of the activity here is presumably the resultant of an undetermined number of radioactive isotopes and the complete decay curve is by no means available. On the basis of Japanese measurements made soon after the explosion, the apparent half-life was approximately 10 to 14 days. Sixty to 70 days following the explosion the half-life increased to approximately 90 days in the NAGASAKI center area. This latter value is at present a field approximation and must be taken with [illegible] conservation.

The activity in the NISHIYAMA area is most certainly the result of fission products deposited from the cloud formed by the explosion. The weather on 9 August 1945 at NAGASAKI was clear and warm with a light west southwest wind. Residents in the NISHIYAMA area tell of the cloud passing over the region and droplets of yellow brown liquid falling after the explosion occurred. The geography of the NISHIYAMA area is such that a range of hills is interposed between the reservoir and the explosion hypocenter. The east side of the NISHIYAMA valley was well out of a direct line from the explosion center. Yet relatively high residual radioactivity was detected in the latter area. Furthermore, definite traces of residual activity were detected on the SHIMABARA Peninsula, some 20 miles to the west of the NAGASAKI hypocenter; and the Japanese reported traces of activity in KUMAMOTO, some 50 miles to the west of the hypocenter.

The radioactive material at NISHIYAMA had a half-life variously estimated to be from 30 to 75 days, and appeared to be made up of distinctly different isotopes from that at the hypocenter. One indication of this came from the different proportion of beta to gamma radiation in the two areas, the beta fraction being much higher at NISHIYAMA than at the center area.

The relative intensity in the two areas is of considrable interest physiologically. At the NAGASAKI center area the residual intensity at the hypocenter on 18 October 1945 was 53μ r/hr which is well below the minimum tolerance dose of 4000μ r/hr. Even assuming a rapid decay directly following the explosion, it is questionable whether physiologically significant residual radioactivity occurred in the center area at any time after the blast. This conclusion was partly verified by interviews with a number of persons who were not exposed to the explosion proper but who entered the explosion area shortly thereafter. They have been residing there almost continuously since that time. Their blood was examined by the Japanese and found to be essentially normal. On interview, they had no physical complaints nor any history of ill effects since 9 August.

The situation at NISHIYAMA was somewhat different. Here many values in excess of 800μ r/hr were obtained, and the highest value measured was 1080μ r/hr. These values were determined about 15 November, some 100 days following the explosion, and are within the order of magnitude of the minimum tolerance dose of 4000μ r/hr. In view of the somewhat shorter apparent half-life at NISHIYAMA, it is possible that physiologically significant radiation was received by the inhabitants of this area for at least a short time after the explosion. Japanese blood studies made in this area about 1 October tend to substantiate this view, as a moderate leukocytocis was observed by these investigators. However, blood studies made on NISHIYAMA residents by NavTechJap Team 11-100 on 16 to 19 November showed a normal blood picture, indicating that complete recovery had apparently occurred. In general, it may be said that there was a possible transitory period of not more than 90 days during which sufficient residual radioactivity remained in the NISHIYAMA area to produce barely perceptible physiological effects.

The maximum radiation intensity measured at HIROSHIMA on 1 November 1945 was 61μ r/hr in the center area. The situation here may be regarded as parrallel to that in the NAGASAKI center area insofar as physiological significance is concerned. It may be concluded that the residual radiation was not physiologically significant following the explosion proper.

The highest measured radiation intensity in the TAKASU area on 1 November 1945 was 28μ r/hr. At least two components of the active material have been isolated by the Japanese, a barium fraction of 13.3 day half-life, and a strontium fraction of 51 day half-life. It is possible, although not probable, that for a short time following the explosion, the residual activity approached physiologically significant levels; however, at present the radiation is not significant.

The comparative sizes of the central radioactive areas at NAGASAKI and HIROSHIMA are shown in Table 1. It may be seen from this table that at NAGASAKI the absolute area within each contour is smaller than at HIROSHIMA; and, from the ratio of the corresponding areas at each site, it is evident that this difference is essentially a constant one - the NAGASAKI areas being about 65 percent of those at HIROSHIMA.

An interesting difference between the two explosions lies in the fact that although the NAGASAKI bomb exploded nearer to the ground, roughly 490 meters, as compared with the Japanese estimate of 590 meters at HIROSHIMA, the residual intensity is lower at the center in NAGASAKI than at HIROSHIMA. An explanation for this may be that the two bombs were of different types.

TABLE I
COMPARISON OF AREAS OF RADIOACTIVITY AT NAGASAKI AND HIROSHIMA
(Based on Radioactivity Maps)

Intensity Contour	Major Radius (Meters)		Minor Radius (Meters)		Mean Radius (Meters)		Approx. Area (Km^2)		Ratio of (Areas)	Multiples of 50μ r/hr Area	
	N	H	N	H	N	H	N	H	N/H	N	H
50μ r/hr	100	90	25	60	63	75	.012	.018	.667	1.00	1.00
40μ r/hr	125	140	88	80	106	110	.035	.038	.921	2.92	2.11
30μ r/hr	250	265	138	230	194	248	.118	.193	.611	9.83	10.7
20μ r/hr	350	425	238	313	294	369	.270	.428	.631	22.50	23.8
10μ r/hr	500	510	325	475	413	493	.534	.749	.713	44.5	41.6
5μ r/hr	675	900	475	825	575	858	1.043	2.310	.451	86.9	128.3

N = NAGASAKI H = HIROSHIMA

From the foregoing data it may be concluded that personnel may enter an area under conditions prevailing at HIROSHIMA and the center and peripheral areas at NAGASAKI (aside from NISHIYAMA) without danger immediately after such an atomic bomb has exploded, and remain there indefinitely without harm from radiation. However, a deposit of fission products such as exists at NISHIYAMA may be potentially dangerous up to 60 days or more after the explosion, provided continuous exposure of personnel occurs.

The danger from residual radation may become real by exploding the bomb at a lower level, increasing the amount of material, or enhancing the activity of reaction.

* * * * *

Part III
OTHER ASPECTS OF THE ATOMIC BOMB

Several points related to the main thesis will be considered below. Since most of these will undoubtedly be taken up by the U.S. Strategic Bombing Survey, they will be given only cursory consideration here.

Effect on Plant Life:

Vegetation was scorched and many trees uprooted within a radius of three to four kilometers both at HIROSHIMA and NAGASAKI. Many trees and shrubs withstood the blast, however, and were only stripped of foliage and lightly scorched. Most of the latter had leafed out again by mid-October and showed no special abnormalities. Root vegetables, as carrots and radish, put out new leaves.

Effect on Water:

The center of the bomb at HIROSHIMA was four kilometers from the harbor; the center at NAGASAKI was three kilometers distant. At neither place was a tidal wave produced. The temperature of the water was not observed to change. Fish and shell fish were not killed. Small craft (up to 100 tons) in the rivers and canals within three kilometers of the center were sunk. Vessels in the harbor or at docks were reported not to be damaged seriously, although some plates and beams were sprung.

Effective Types of Shelters:

The simplest type of shelter was effective in protecting personnel from radiation, heat and blast damage. Many small shelters that were made only of 50 centimeters to a meter of earth heaped over bamboo poles did not collapse. People in such shelters at the time of the explosion, even close to the center, were not injured, if the shelter opening was away from the bomb.

At the time the bomb exploded in each city, many people thought all danger had passed and had largely left the shelters.

Shelters of even elaborate types or hillside caves are inadequate, if the mouths are open directly to the center of explosion. Baffling is essential. There were several cases of persons being severely burned within an unbaffled portion of a shelter while those less than two feet away, but behind the baffle, were unharmed.

As will be noted from the body of the report, persons in concrete buildings were partially protected, if not near windows or other openings, but many near the hypocenter received serious or fatal radiation injury as a result of secondary scatter of radiation within the room.

Organization of Relief:

No effective relief organization existed at either HIROSHIMA or NAGASAKI, nor did effective organized help materialize from the central government or other agency. This lack was due to the national disorganization and impending defeat; to the Japanese callousness toward casualties; and to the magnitude of the damage inflicted.

No form of blood bank or reserve of blood or plasma existed.

A striking evidence of the total disorganization was that no effective effort was made other than by the American forces to clear streets, level ruins or even seal off broken water pipes.

Gradually, shacks have been haphazardly built in the ruins by survivors or squatters.

1. HIROSHIMA.

According to Father Siemes, more than 30 hours elapsed before the first official rescue party was on the scene at HIROSHIMA. Emergency care was given patients who could reach hospitals or shelter by themselves or with the aid of friends the first evening, but no organized relief was in evidence. Little could be done for those who reached hospitals or aid stations except to provide some with shelter, water, a little food and emergency care.

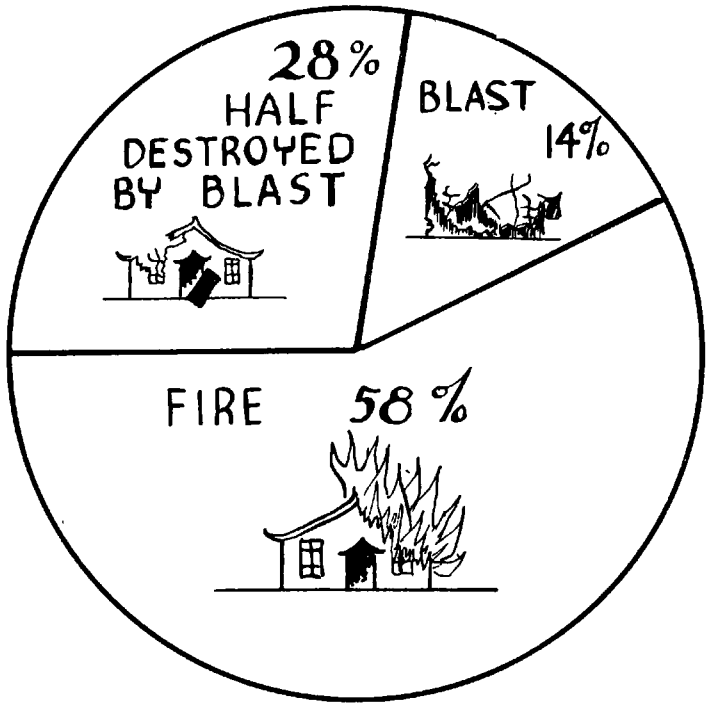
Many trapped in the ruins died by fire or shock unnecessarily.

No attempt was made to give blood or plasma transfusions, nor were blood or blood substitutes [illegible]. Burns were treated with zinc ointment or

GRAPH 9

EFFECT UPON WOODEN HOUSES

NAGASKI



4. A number of persons died of radiation effects secondary to the explosion, with or without other injury. Many persons within two kilometers of the hypocenter would have died of radiation injury had not death from other causes intervened.

5. Japanese relief organization was non-existent for all practical purposes.

6. Had adequate rescue crews and medical facilities been available, the deaths could probably have been reduced by one-half.

7. Reinforced concrete buildings in general stood the blast adquately. They protected those individuals within them who were not exposed through windows and other openings, although near the hypocenter secondary radiation from floors and walls killed or injured many.

8. Even simple earth air-raid shelters provided adequate protection if baffled.

9. Atomic bombs of the types exploded at HIROSHIMA and NAGASAKI, and at a height of 500 meters or over, create no subterranean disturbance.

10. Atomic bombs of the present type, exploded about 500 meters high in air and at a distance of three or more kilometers from shipping, did not seriously damage vessels of over 100 tons displacement.

11. The effect of exploding atomic bombs in water is totally unknown.

12. Residual radioactivity is not a danger with the atomic bombs as used at NAGASAKI and HIROSHIMA.

13. In order to group atomic bomb radiation casualties with radiation reaction as a whole and to define the characteristic source of the radiation received, it is suggested that they be classified as: Radiation reaction (atomic).

* * * * *

Part VI
RECOMMENDATIONS

1. This report should be publicized widely as soon as national policy with regard to the atomic bomb permits, in order to counteract much of the misinformation that bas reached the public.

2. Study of atomic bomb cases should be continued, perhaps at yearly intervals, for at least ten years. Cooperation with Japanese scientists in this is essential.

3. Accurate vital statistics, particularly with regard to births and deaths, should be kept on all persons known to have been within five kilometers of the bomb explosions.

4. Special study should be made of the population of the NISHIYAMA region of NAGASAKI, where residual radioactivity has been relatively high.

5. Joint conferences with the Manhattan Project Group, the Army Medical Group, and this team are desirable to correlate information, guide research, and to issue a complete and authoritative medical report so that all doctors will know how to treat atomic bomb victims, and so that effective relief organizations may be set up to be used in case of need.

NAGASAKI POLICE DAMAGE MAP

SCALE

1/2 3/8 1/4 1/8 0 1 2

LEGEND

(A) EXPLOSION CENTER

(B) AREA TOTALLY DESTROYED AND TOTALLY BURNED

About 2 K.M. East to West
About 3 K.M. North to South
Area about 4.7 S.Q. K.M.

(C) AREA BURNED OUT

About 4 K.M. East to West
About 7 K.M. North to South
Area about 20 S.Q. K.M.

(D) AREA HALF DESTROYED OR PARTLY DAMAGED

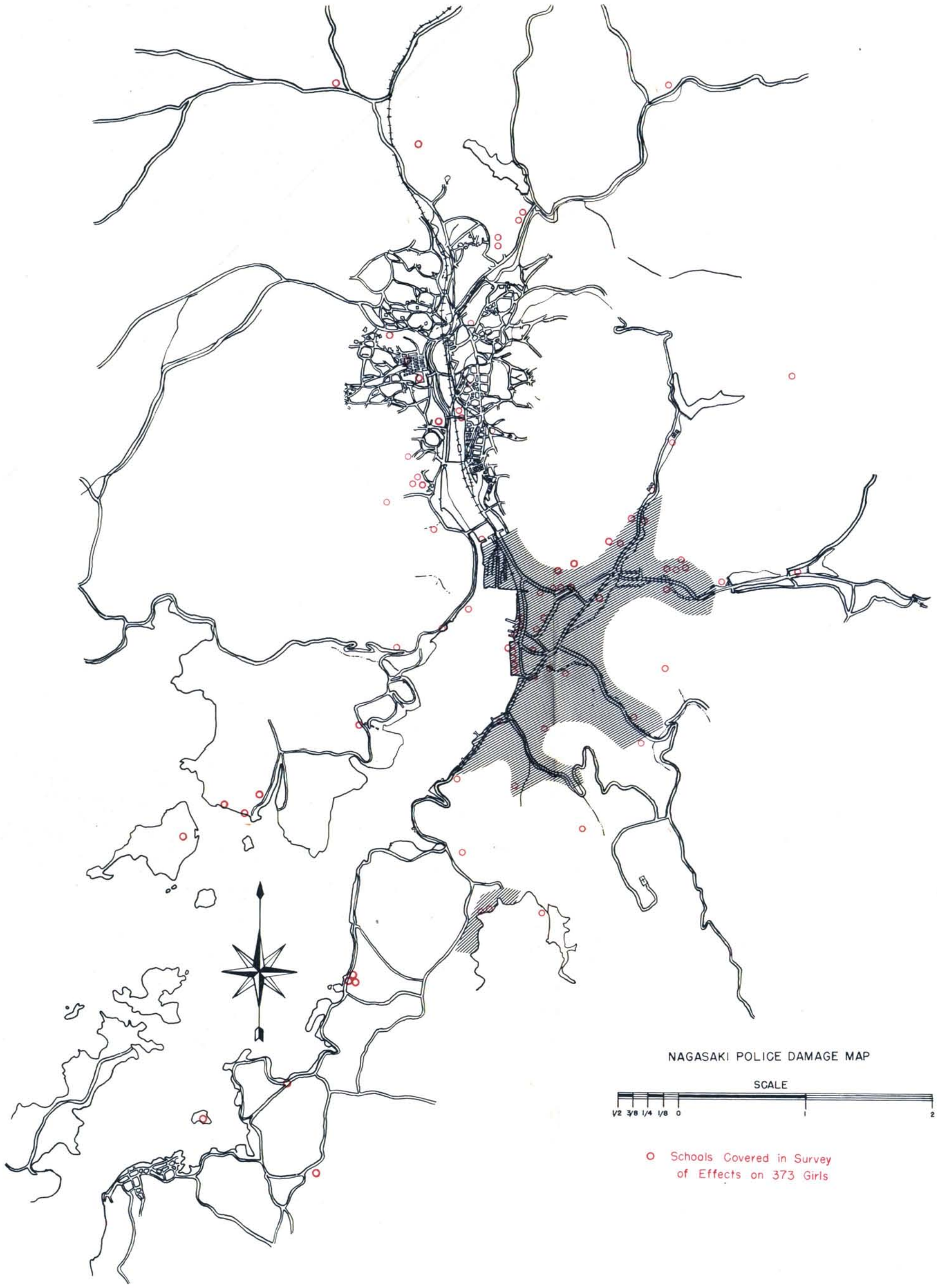
About 9 K.M. East to West
About 18 K.M. North to South
Area about 104 S.Q. K.M.

ENCLOSURE (D)

ENCLOSURE (E)

POPULATION OF NAGASAKI CITY
Nov. 1, 1945 Census

Age	Men	Women	Total	Age	Men	Women	Total
1	1153	1104	2257	51	723	760	1483
2	1740	1787	3527	52	738	664	1402
3	1674	1584	3258	53	721	636	1357
4	1584	1660	3244	54	684	640	1324
5	1813	1735	3548	55	552	572	1124
6	1553	1491	3044	56	582	554	1136
7	1480	1375	2855	57	551	546	1097
8	1258	1352	2610	58	553	561	1114
9	1452	1330	2782	59	457	507	964
10	1375	1385	2760	60	421	455	876
11	1516	1461	2977	61	403	426	829
12	1470	1453	2923	62	404	404	808
13	1580	1556	3136	63	363	403	766
14	1792	1682	3474	64	303	380	683
15	1774	1781	3555	65	346	420	766
16	1881	1587	3468	66	266	368	634
17	2091	1807	3898	67	278	345	623
18	1939	1654	3593	68	239	296	535
19	1876	1608	3484	69	208	340	548
20	1680	1670	3350	70	190	314	504
21	1717	1508	3225	71	165	222	387
22	1551	1492	3043	72	161	228	389
23	1059	1496	2555	73	132	213	345
24	819	1427	2246	74	105	201	306
25	754	1426	2180	75	111	157	268
26	712	1278	1990	76	58	135	193
27	771	1109	1880	77	81	116	197
28	985	1076	2061	78	67	117	184
29	855	1013	1868	79	48	87	135
30	913	1036	1949	80	38	91	129
31	829	908	1737	81	30	69	99
32	926	943	1869	82	27	48	75
33	834	919	1753	83	26	44	70
34	806	972	1778	84	9	29	38
35	841	955	1796	85	5	28	33
36	850	960	1810	86	7	30	37
37	832	938	1770	87	4	12	16
38	801	894	1695	88	5	13	18
39	878	989	1867	89	5	9	14
40	905	761	1666	90	7	8	15
41	830	856	1686	91	1	4	5
42	921	892	1813	92		7	7
43	867	887	1754	93		3	3
44	882	880	1762	94		1	1
45	851	822	1673	95	1	1	2
46	877	846	1723	96		2	2
47	788	812	1600	97		1	1
48	869	811	1680	98	1		1
49	771	743	1514	99		1	1
50	738	780	1518	Total	69789	72959	142748



ENCLOSURE (G)

ENCLOSURE (H)

TABLE I(H)

ESTIMATES OF SCHOOL ENROLLMENT, NAGASAKI
ATTENDANCE AT SCHOOL
Number of Registered Students by School Districts

School District	Prim.	High	All	July 1945 All	20 Sept. 1945 All	Teachers & Clerks June 1945
SHINKOZEN	592			541	300	20
TOKIYA	760			760	858	24
KOSHIMA	986			986	972	20
KITAOURA	875			859	850	26
ZANZA	932			902	64	26
AKUNOURA	969			969	763	23
ASAHI	864			864	782	24
INASA	906			870	400	33
SHIROYAMA	1324			1324	35	37
YAMAZATO	1581			1581	284	23
NITA	870			865	833	20
MINAMIOURA	796			796	775	29
KATSUYAMA	795	136	931	931	950	27
SAKO	716	289	1005	963	863	17
NAMINOHARA	487	121	608	608	559	
TOMACHI	966	233	1199	1194	1197	25
TATEGAMI	601	148	748	749	783	18
NISHIZAKA	669	174	843	843	223	25
KAMINAGASAKI	901	191	1092	1076	1103	25
IRABAYASHI	1464	141	1605	1583	1687	36
KOGAKURA	323	79	402	410	403	10
DOINOKUBE	763	156	919	904	875	23
KAMINOSHIMA*	256	83	339	303	333	10
KOSAKAKI*	464	83	547	549	554	15
NISHIURAKAMI	1116	195	1311	1311	1015	25
FUCHI		1368	1368	1368	250	38
OURA		617	617	617	592	18
Totals	20976	4014	24990	24746	18670	641

*These two districts appear on map as "KOSAKAKI."

ENCLOSURE (H), continued

TABLE II(H)

CASUALTIES AMONG SCHOOL POPULATION
Report Attributed to Nagasaki Prefectural Education Association
19 October 1945

School District	July	Deaths of School Children	Injured or Damaged at home 20 Sept.	
SHINKOZEN	541	13	264	300
TOKIYA	760	7	59	858
KOSHIMA	986	0	54	972
KITAOURA	859	8	35	850
ZENZA (sic)	902	500	370	64
AKUNOURA	969	4	34	763
ASAHI	864	6	345	782
INASA	870	105	981	400
SHIROYAMA	1324	1300	43	35
YAMAZATO	1581	1400	300	284
NITA	865	6	0	833
MINAMIOURA	796	4	13	775
KATSUYAMA	931	17	60	950
SAKA	963	4	65	863
NAMINOHARA	608	4	53	559
TOMACHI	1194	1	320	1197
TATEGAMI	749	2	3	783
NISHIZAKA	843	14	266	223
KAMINAGASAKI	1076	3	34	1103
IRABAYASHI	1583	2	0	1687
KOGAKURA	410	0	0	403
DOINOKUBE	904	0	0	875
KAMINOSHIMA*	303	0	0	333
KOSAKAKI*	549	0	0	554
NISHIURAKAMI	1311	152	387	1015
FUCHI	1368	500	633	250
OURA	617	1	13	592
Totals	24746	4053	4392	18670

*These two districts appear on map as "KOSAKAKI."

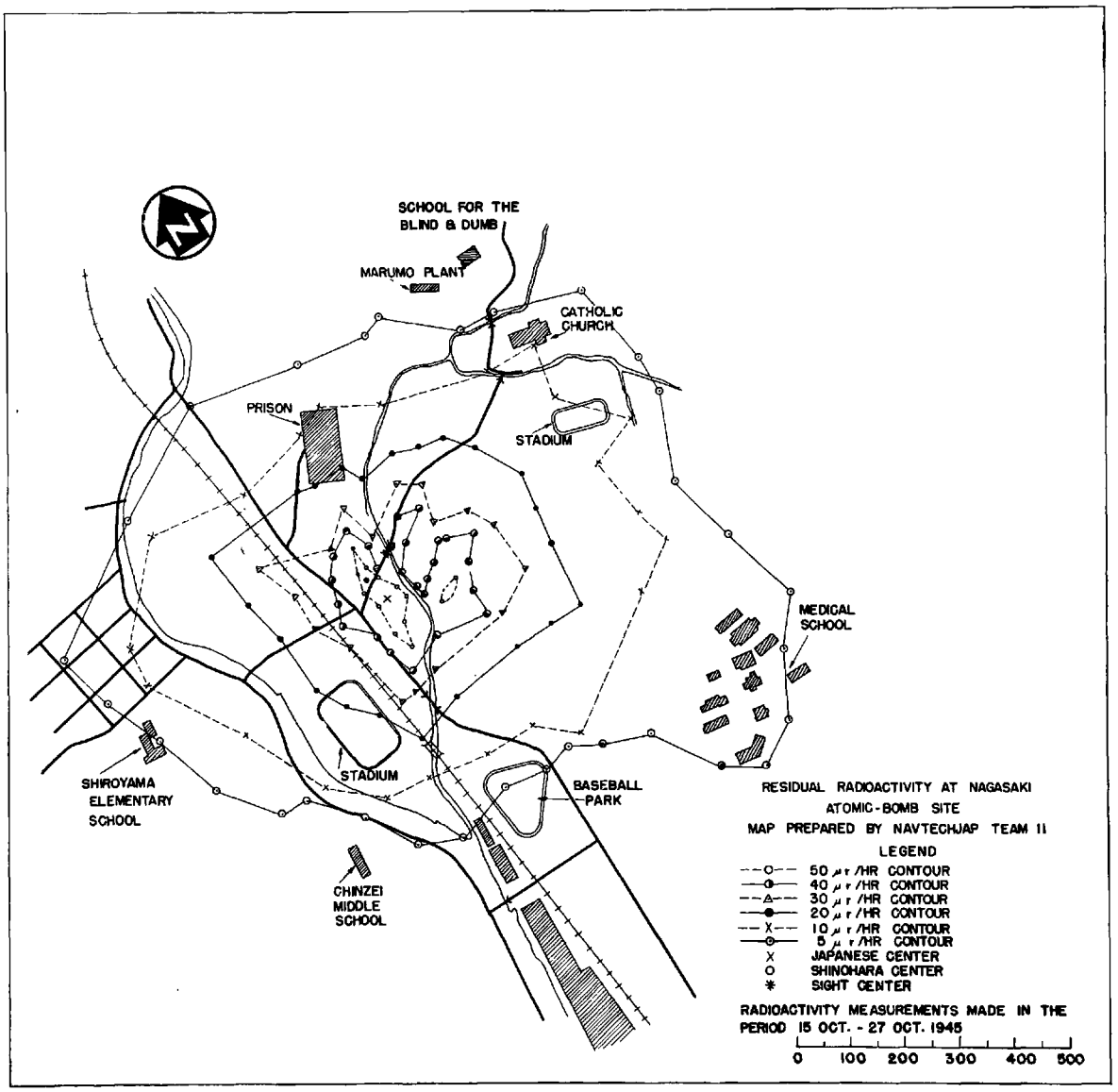
ENCLOSURE (I)

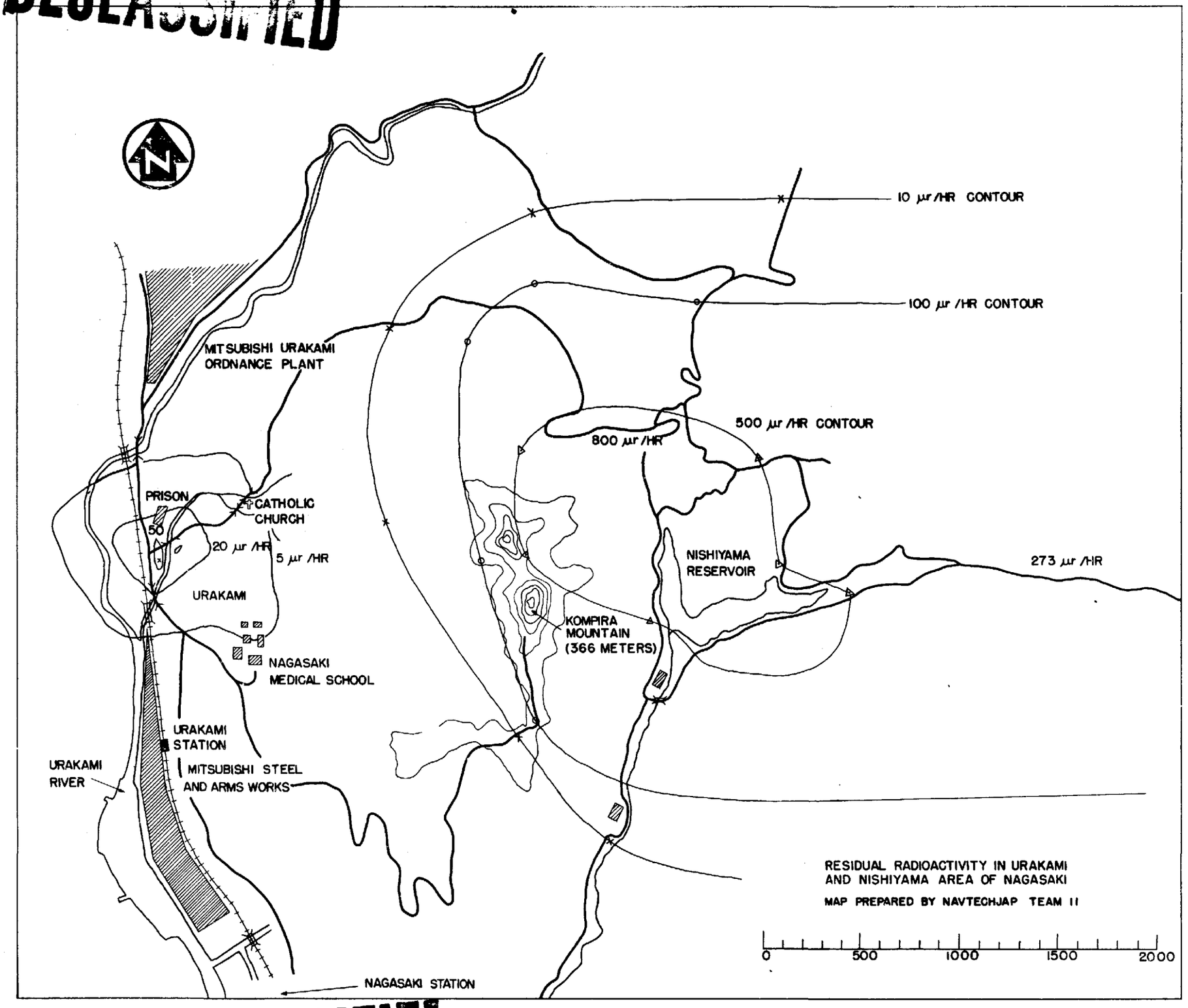
ENCLOSURE (I)
BLOOD PROTEIN STUDIES KYUSHU IMPERIAL UNIVERSITY

No.	sex	age	days after bomb	w.b.c.	r.b.c. (million)	sed. vel. r.b.c. (mm/1h)	sed. vel. r.b.c. (mm/2h)	tot. prot. (g/100cc.)	non pro. n(mg/100cc.)	albumin (g/100cc.)	globumin (g/100cc.)	albumin globumin	suglob. (g/100cc.)	fibrinogen
1	m	19	14	4000	3.50	65	125	7.4	29	0.9	6.5	0.13	6.5	
			45	9700	6.40	32	62	6.1	39	1.3	4.6	0.32	2.4	
2	f	45	27	3600	1.70	95	138	5.8	28	0.9	5.0	0.06	4.6	
			58	8400	3.20	98	121	6.8	38	0.9	5.6	0.15	2.9	
3	f	46	31	6800	2.50	98	144	5.6	49	0.7	4.9	0.14	4.6	
			51	12800	4.30	6	17	6.0	21	1.5	4.3	0.35	2.1	320
4	f	20	19	1200	2.00	104	154	6.2	48	0.7	5.4	0.13		
			50	8000	4.00	36	51	6.8	32	1.3	3.7	0.35	0.5	314
5	f	20	32	3400	1.90	143	146	6.7	49	2.4	4.2	0.57	2.0	568
			63	11800	4.00	40	92	6.8	35	0.7	5.7	0.12	2.9	578
6	m	20	28	7600	3.60	97	143	7.0	49	0.8	5.9	0.15	0.7	270
			59	6300	4.00	20	46	6.3	22	1.8	4.3	0.42	2.3	491
7	m	52	26	5200	4.40	10	28	4.8	25	0.5	3.6	0.14	0.2	254
			57	4300	2.10	2	7	5.2	32	1.3	3.7	0.35	0.5	314
8	m	24	20	800	2.70	100	136	6.4	25	0.7	5.6	0.12	5.1	
9	m	22	46	4600	3.40	21	53	6.4	28	2.2	4.0	0.35	2.0	639
10	m	43	54	4200	4.60	32	80	6.4	36	1.0	5.1	0.19	1.6	633
11	m	59	56	6600	3.10	131	149	6.9	44	0.2	6.4	0.03	3.5	398
12	m	34	19	6800	2.40	60	120	6.6	38	0.7	5.5	0.13	0.6	227
13	m	30	12	3500	2.70	54	124	5.7	62	1.6	4.2	0.36	1.2	219
14	m	30	26	2400	2.50	40	84	6.3	44	0.8	5.0	0.16	0.1	65
15	m	18	12	3200	2.40	35	112	6.7	53	1.0	5.3	0.19	3.0	407
16	f	18	50	5000	3.60	134	143	6.9	31	1.4	5.3	0.27	3.9	538
17	m	19	78	7400	5.70	20	48	6.9	23	1.3	5.5	0.23	1.2	149
18	f	17	78	6100	4.30	43	84	6.3	26	0.3	5.7	0.05	0.9	
19	f	44	38	7600	3.10	45	96	6.9	36	1.7	4.9	0.38	0.4	
20	m	21	61	7800	4.75	18	48	7.1	27	1.3	5.6	0.23	0.6	496
21	f	17	66	6100	3.30	88	135	7.3	30	1.1	6.0	0.19	1.9	
22	m	16	78	6500	4.10	13	34	7.0	56	1.1	5.4	0.20	0.5	325
23	m	17	78	3300	3.20	36	76	7.6	33	1.5	5.8	0.25	1.5	508
24	f	45	78	5400	2.10	25	52	6.8	31	1.4	5.2	0.27	0.9	393
25	m	16	78	7400	4.30	40	78	5.8	22	0.5	4.9	0.10	0.3	996
26	m	33	78	6200	3.30	35	83	6.7	35	0.7	5.7	0.12	1.5	1022
27	m	19	70	6550	1.91	120		7.5	47	0.5	6.8	0.09	4.5	670
28	f	18	70	8200	3.00	40	65	6.4	43	0.6	5.1	0.12	4.5	302
29	f	17	70	3500	2.40	125	247	6.3	33	0.8	5.2	0.15	4.9	48
30	f	28	70	8600	3.90	25	50	7.0	52	0.6	6.0	0.10	5.2	
31			71	5250		8	15	5.8	35	1.0	4.5	0.22	3.9	142
32	f		71	3900				6.9	49	0.2	6.4	0.03	5.2	417
33	m		71	4000		27	45	5.1	27	0.5	4.4	0.11	3.1	114
34	f		71	3900				6.8	49	0.6	5.9	0.10	3.5	139
35	f		71	4200		50	100	5.1	42	0.3	4.9	0.07	1.9	432
36			71	6450		37	76	6.4	46	0.5	5.6	0.09	1.5	663
37	f		71	7100		50	100	5.4	36	0.1	5.1	0.01	4.0	223
38	f		71	2450		18	50	6.2	14	0.4	5.7	0.07	4.0	259
Standard* m since						4	12	7.0	32	4.2	1.8	0.8	0.5	296
f Aug. 9						8	18	6.9	37	4.3	2.4	1.7	0.5	302

*T.Sa J. Med. Assoc., Formosa, 43, 40, 1944

ENCLOSURE (J)





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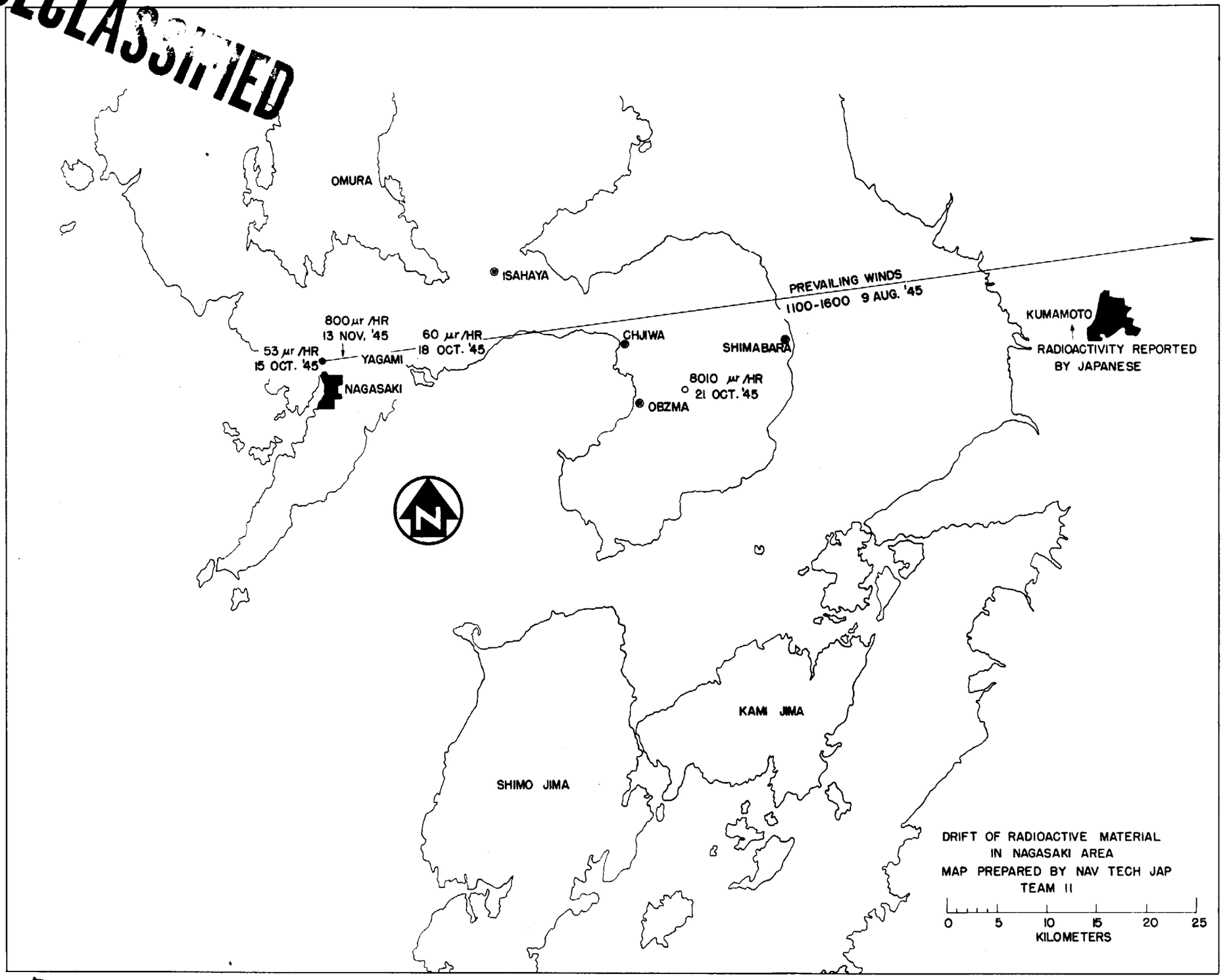

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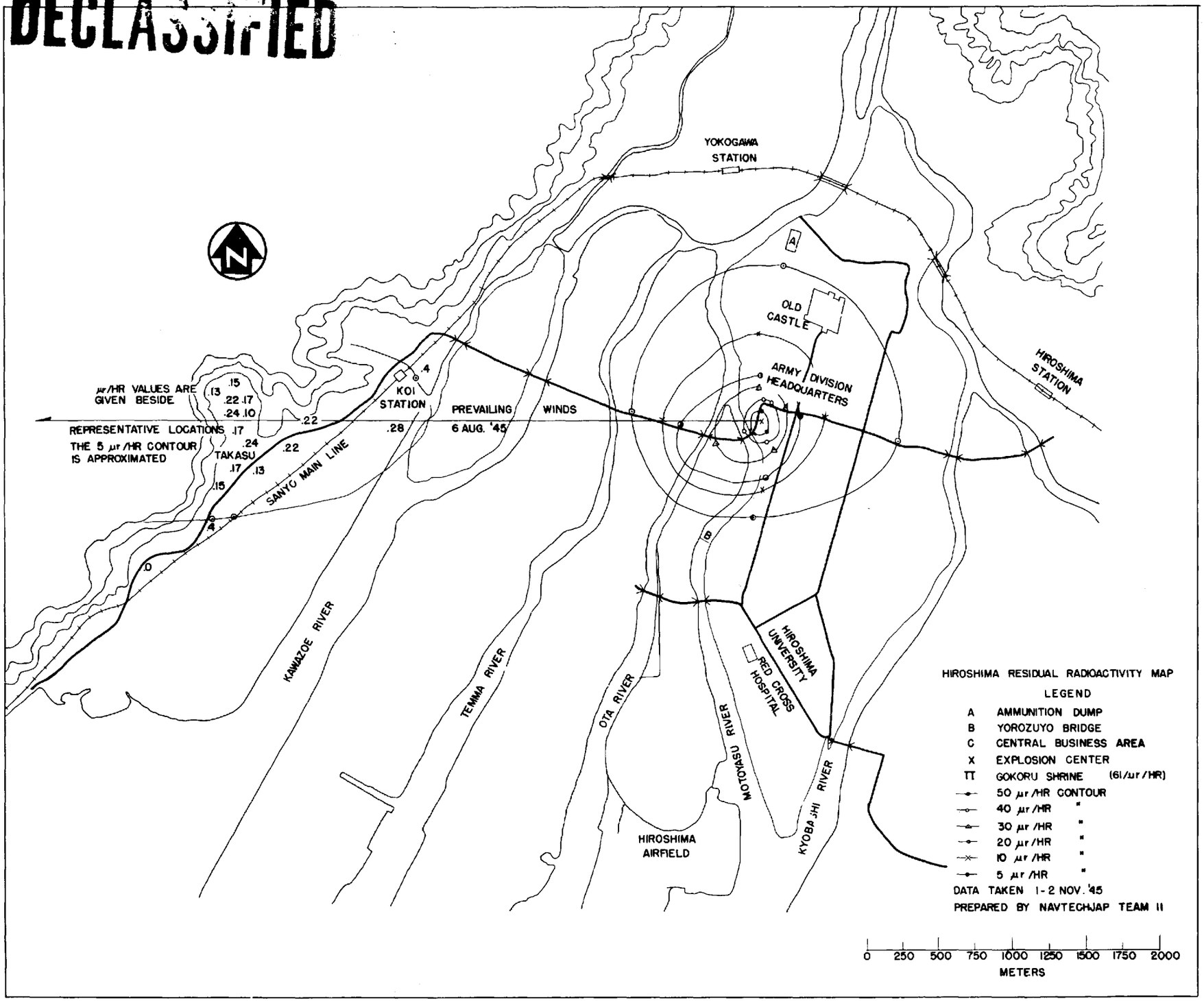


ENCLOSURE (M)

TMJ
MT
X-28-2

NS/an

U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA

29 May 1946

SECRET

From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Atomic Bombs, Hiroshima and Nagasaki, Article 2 - Medical Effects, Supplementary Studies.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering a portion of Target X-28 of Fascicle X-1 of reference (a), is submitted herewith.

2. The report was prepared by Captain Shields Warren, MC (S), USNR.

C. G. GRIMES
Captain, USN

30935

~~SECRET~~

~~Upgraded to T-S by authority of~~
~~OP-32 19 Feb '47~~
~~Serial 000740938~~

Unclassified
X-28-2
CNO-OP322 by authority of
F21/hga Ser 066 5P32 10 May 1950
Name Title Date
in accordance with AR 380-5.

ATOMIC BOMBS, HIROSHIMA AND NAGASAKI

ARTICLE 2

MEDICAL EFFECTS, SUPPLEMENTARY STUDIES

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE X-1, TARGET X-28

MAY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

MISCELLANEOUS TARGETS

ATOMIC BOMBS, HIROSHIMA AND NAGASAKI - ARTICLE 2
MEDICAL EFFECTS, SUPPLEMENTARY STUDIES

There is no essential difference in the tissue changes produced by the bombs dropped at HIROSHIMA and NAGASAKI.

Atomic bomb injuries may be classified as follows:

1. Air blast injury.

    a. Primary, due to thrust or compression of sonic wave.
    b. Secondary, due to impact with wreckage.

2. Radiation blast injury.

    a. Thermal radiation blast injury.

        (1) Primary, flash burn due to radiant heat.
        (2) Secondary, due to burn from induced fire.

    b. Ionizing radiation blast injury.

        (1) Primary, due to gamma rays and neutrons.
        (2) Secondary, due to induced radiation.
        (3) Tertiary, due to residual radiation.

Changes clearly due to the effect of ionizing radiation blast include lymphoid atrophy, damage to hematopoietic tissue, production of leukopenia, injury to gonadal tissue and epilation.

LIST OF ILLUSTRATIONS

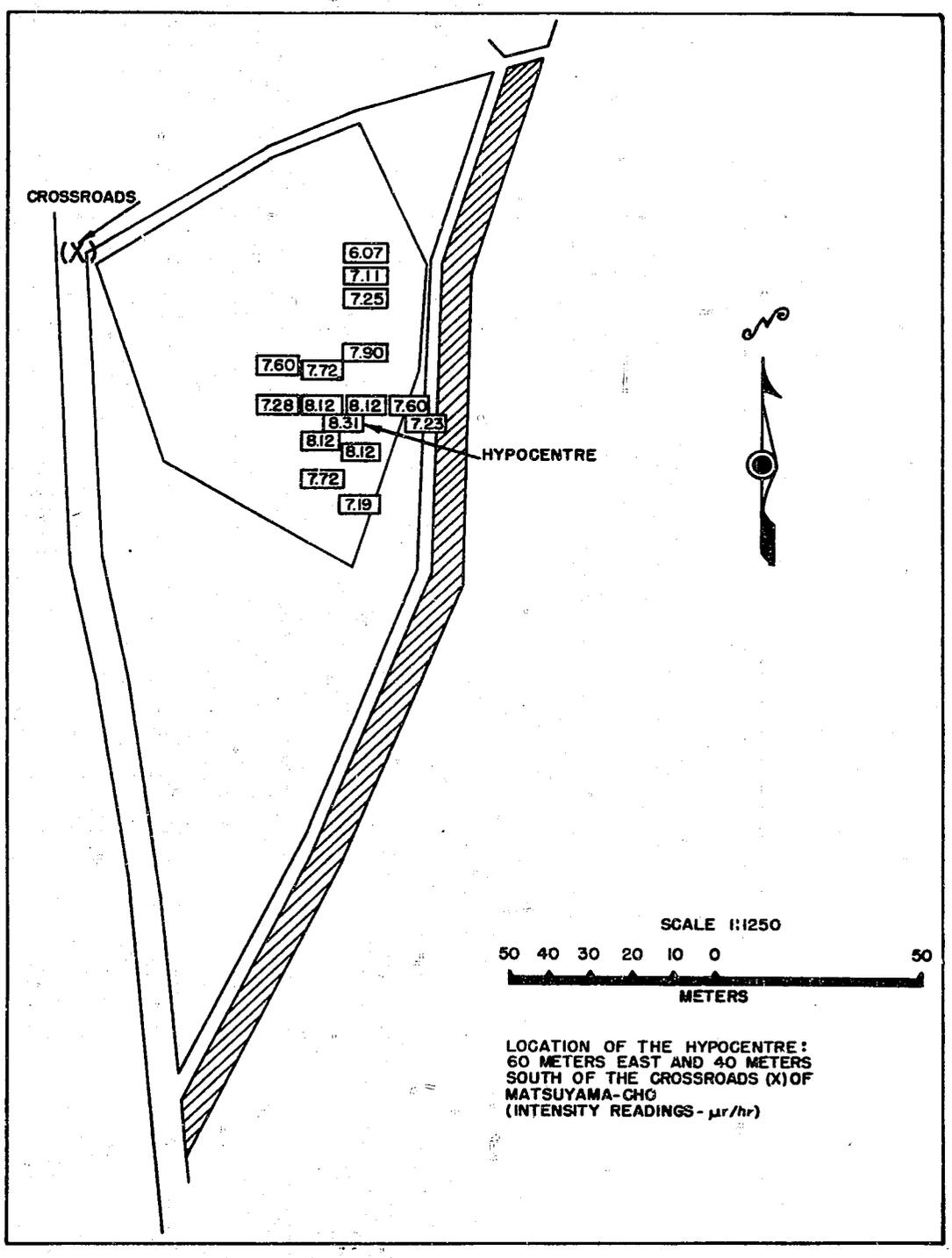


Figure 1

DETERMINATION OF HYPOCENTRE FROM INTENSITY DISTRIBUTION NAGASAKI 27 DECEMBER 1945

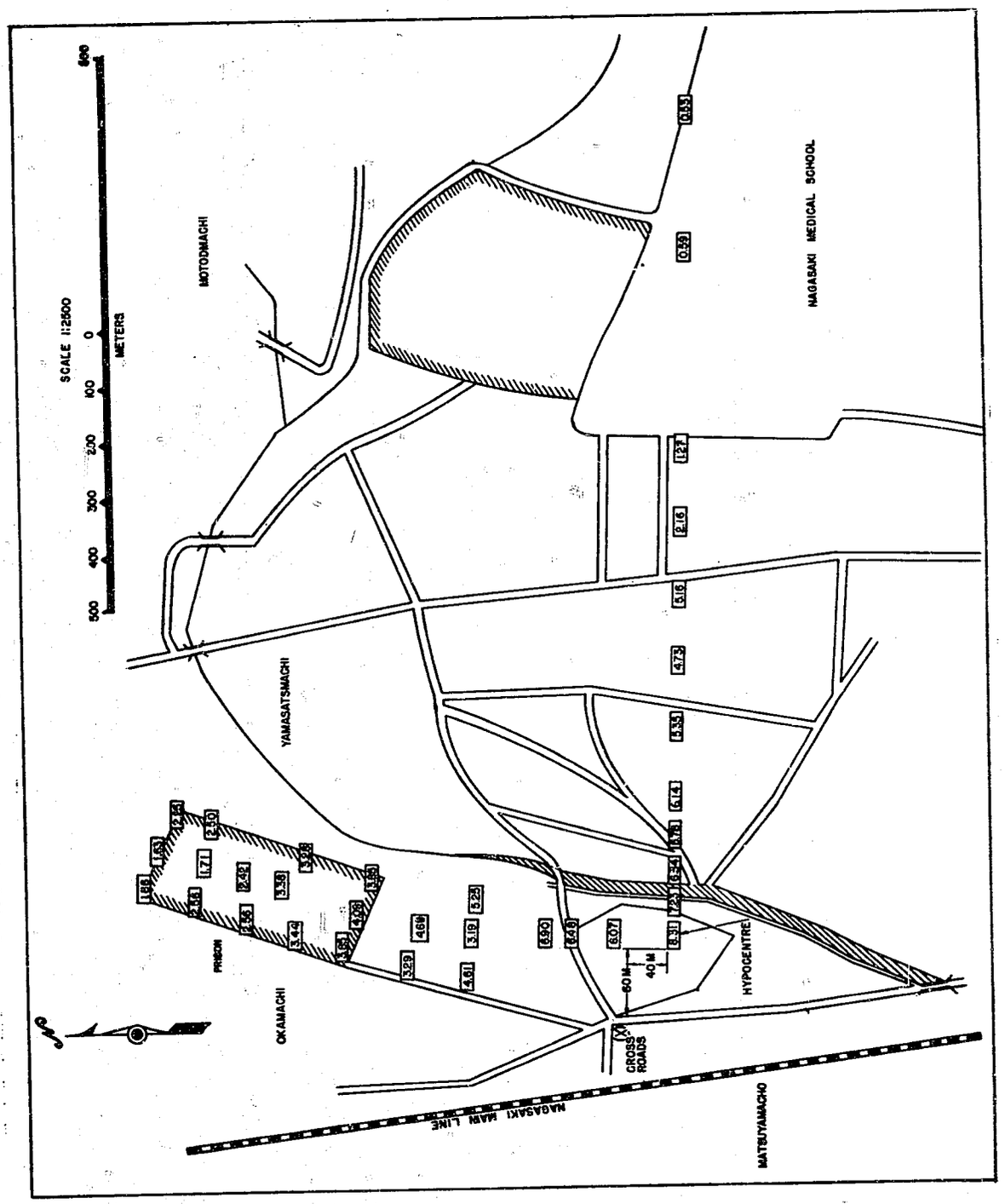


Figure 2
RESIDUAL RADIO-ACTIVITY AT NAGASAKI
(μr/hr) 26-29 DECEMBER 1946

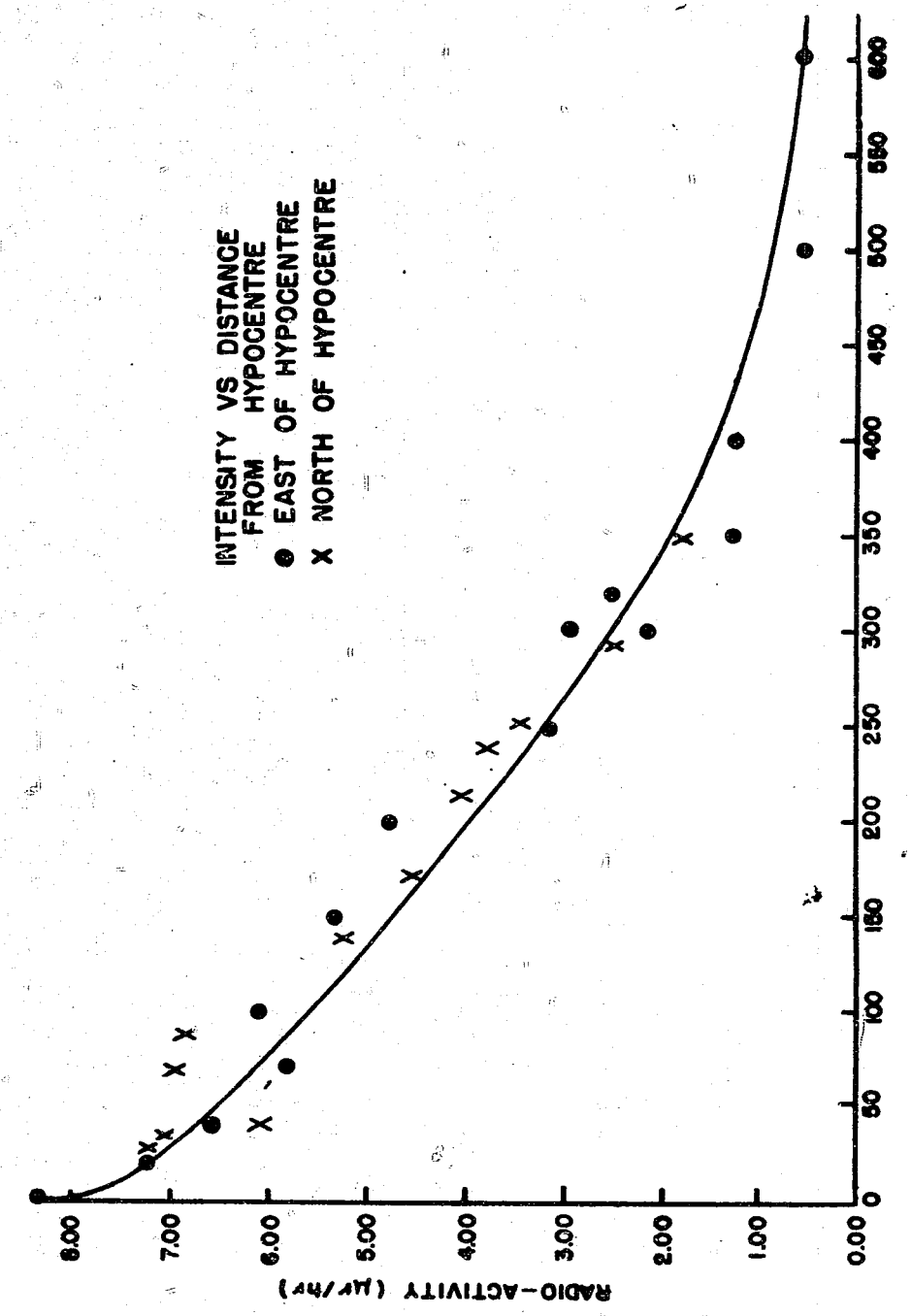
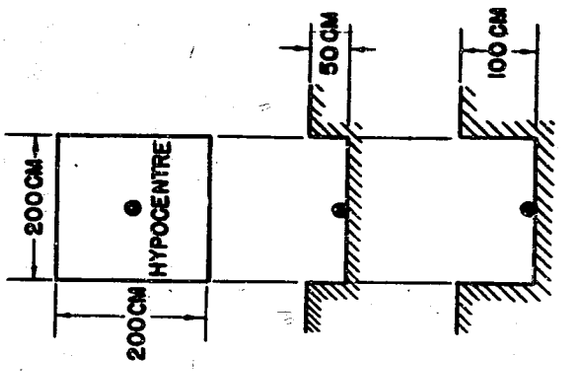


Figure 3
RESIDUAL RADIO-ACTIVITY AT NAGASAKI
26-29 DECEMBER 1946



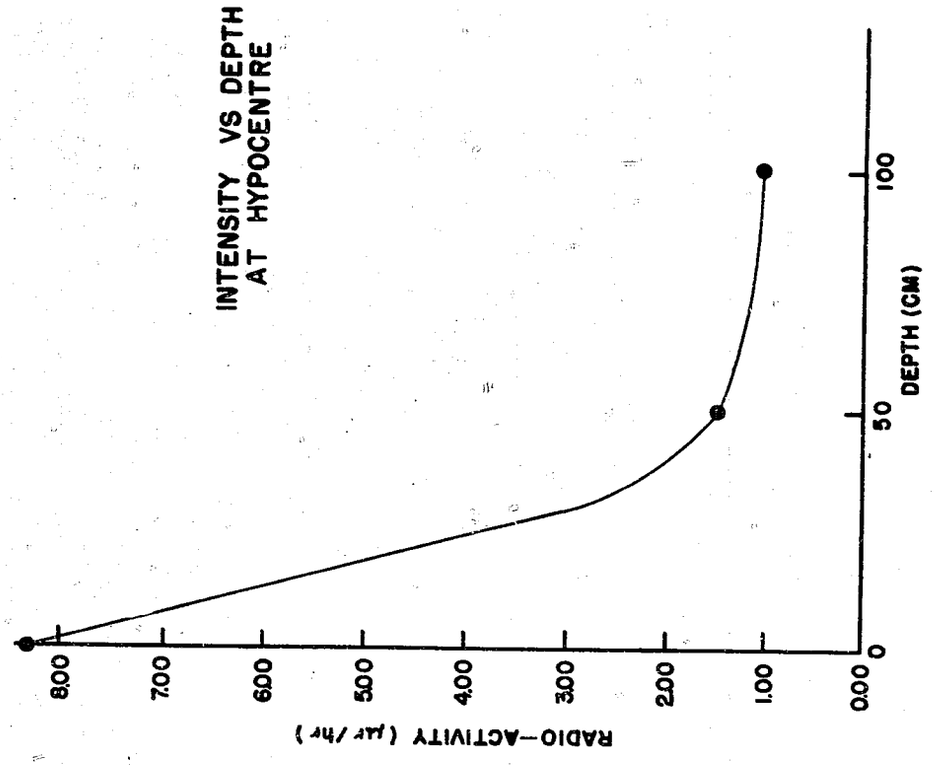


Figure 4
RESIDUAL RADIO-ACTIVITY A
7 DECEMBER 1945

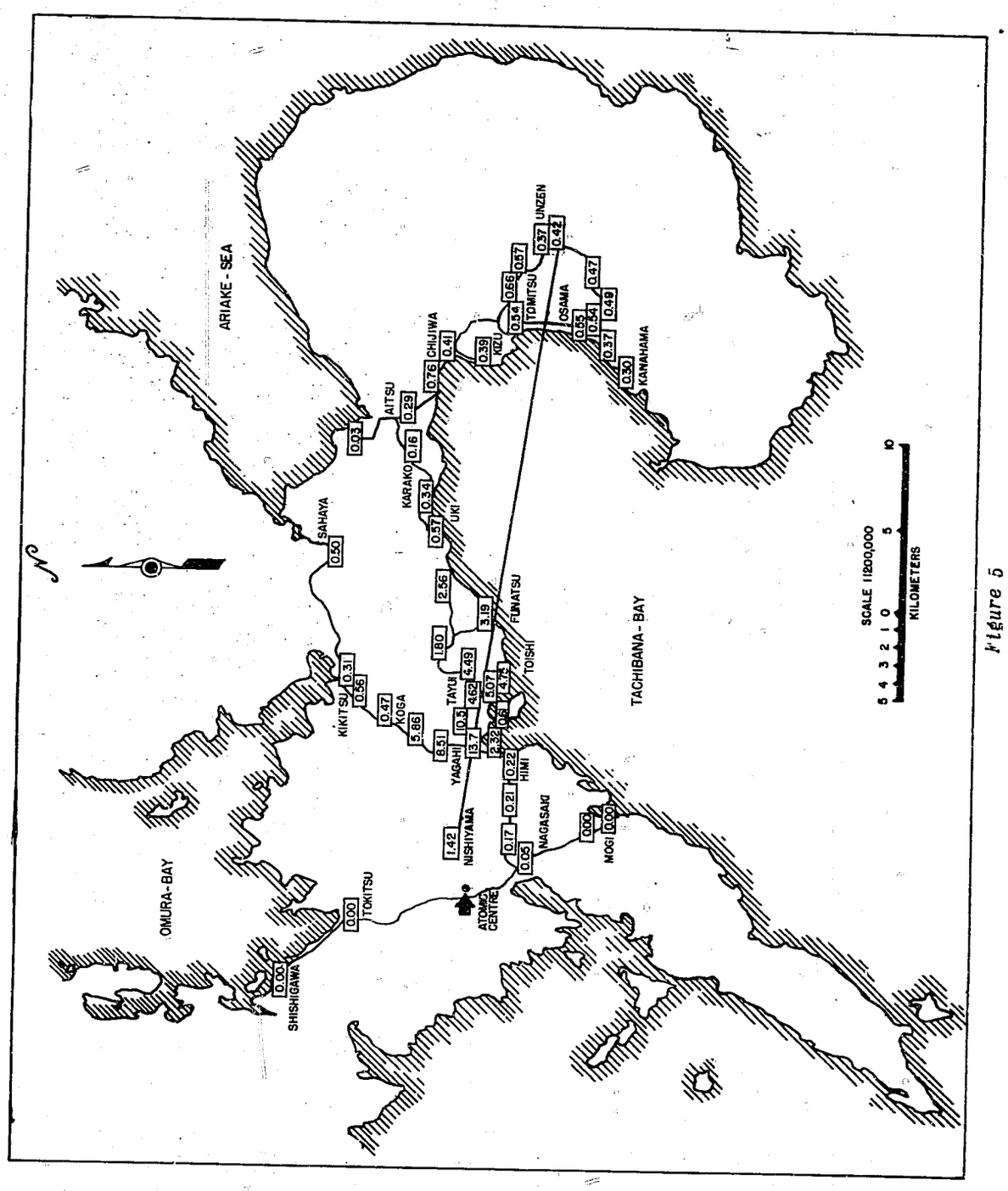


Figure 5
RESIDUAL RADIO-ACTIVITY IN NAGASAKI AND ENVIRONS (μr/hr)
25 DECEMBER 1945 - 9 JANUARY 1946