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

TMJ

MT

X-28-1

15 December 1945

SECRET

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

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X-28-1

Upgraded to T-S by authority of
CNO Ltr 19 Feb 47
Serial 000790P32

Classification cancelled/changed to
Confidential by authority of
CNO - OP 322 F2/hga *10 May 1950*
Serial 006615 P32 Title Date
in accordance with AR 500-5.

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

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U.S. NAVAL TECHNICAL MISSION TO JAPAN

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SUMMARY

MISCELLANEOUS TARGETS

ATOMIC BOMB, HIROSHIMA AND NAGASAKI - ARTICLE 1 MEDICAL EFFECTS

This report covers the medical effects of the atomic bombs dropped on HIROSHIMA 6 August 1945, and on NAGASAKI 9 August 1945. It also analyzes the physical damage as related to death and injury of personnel, the organization of relief activities by the Japanese, and their methods of treatment, which were inadequate to a startling degree. The question of residual radioactivity is thoroughly considered on the basis of our own and Japanese observations, and it is concluded that only negligible danger to personnel existed after the explosion.

The great majority of casualties resulted from burn, blast or secondary injury from debris, while many survivors within a radius of four kilometers suffered from radiation effects of varying intensity. Some of these latter cases are still dying, some may reproduce abnormal offspring, and others may be permanently sterile.

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INTRODUCTION

The atomic bombs detonated at HIROSHIMA and NAGASAKI herald a new era in destruction. Since much of what has been written in the press about their effects has been wholly or partly erroneous, we have felt obliged to include some physical data in this report as a basis for understanding the medical aspects.

We did not see our first patient suffering from effects of the bomb until 20 September 1945, and could not make physical studies until several days later. Therefore, we are dependent on the Japanese for all data bearing on the early effects. Some cases were seen at NAGASAKI by Comdr. Timmes of the USS WICHITA and by officers of the USS HAVEN in mid-September, and about the same time, a brief medical survey was made by the Manhattan Project Group.

We are entirely dependent on Japanese figures for number and type of casualties, population shifts, etc. Since many of these figures have seemed inaccurate, we have attempted to check them by contrasting with one another eyewitness accounts, opinions of officials, census figures, rationing figures, police figures on movements of people from one area to another, factory payrolls and other basic data. Wing Comdr. Bronowski, RAF, associated with USSBS, called our attention to the rice-rationing figures at NAGASAKI and gave us the result of his analysis of them. These compared closely with our estimates.

Practically every Imperial Japanese University and some prefectural colleges sent groups to study the bombed cities; we have interviewed nearly all the members, and studied and correlated their data. Almost the entire group from the Imperial University of Kyoto were killed and their data destroyed by a landslide during a typhoon about 25 September 1945.

In considering the Japanese data, due allowance must be made for the backward character of Japanese medicine and the natural desire of the Japanese to color the truth for propaganda purposes.

Moreover, errors due to language difficulty, to desire of the person questioned to please the examiner, and to ignorance are bound to creep in.

Japanese instruments used for measurements of radio-activity have been checked against ours, and with certain corrections the measurements made with them can be accepted.

Since Japanese doctors have long been interested in study of the blood cells, much of their information on blood changes is accurate and may be depended on to a considerable degree.

It was our good fortune to contact early the Joint US Army-Imperial Japanese Government Commission studying the bomb effects, and we have cooperated with them throughout. Our indebtedness is here acknowledged. Neither we nor they could have accomplished so much alone.

Since the NAGASAKI bomb was more powerful than the one at HIROSHIMA, and of the type more likely to be used in the future, we chose to concentrate our studies chiefly on it. The Japanese Government placed at our joint disposal several wards in the Omura Naval Hospital for study of bomb patients, and we also made use of the emergency "hospital" in the Shinkozen School at NAGASAKI.

Our hospital corpsmen were of great service in obtaining information on the patients through clinical laboratory studies.

Introduction Continued

The HIROSHIMA and NAGASAKI bombs are similar in their qualitative effects. Their effects differ chiefly quantitatively. The terrain at HIROSHIMA is flat; that at NAGASAKI hilly, and the bombed area was only partly inhabited. Hence we shall parallel, and where possible combine, the information obtained on each; presenting the HIROSHIMA data first, the NAGASAKI second, in each category of information.

The Army Medical Group has most kindly made available to us their casualty survey obtained by questioning about 7000 survivors at HIROSHIMA and 5000 at NAGASAKI, so we have concentrated on clinical and laboratory studies of survivors. Statistical tabulations have been made at present by analysis of random samples only. A full study will be made later with the aid of IBM punch cards.

Autopsy material obtained here must be prepared and studied microscopically in the United States.

This report must therefore be considered as semi-final.

THE REPORT

Part I GENERAL ASPECTS

In any consideration of data obtained from lay sources several factors favoring error must be kept in mind. The first of these is the difficulty due to language and the problem of conveying shades of meaning. For example, one patient on a sampan stated on initial examination that his clothing spontaneously burst into flames as a result of the action of the bomb, but on careful questioning and thorough checking of his statement the following story was obtained. The blast of the bomb blew him overboard; he swam ashore, found that the wharf was on fire but climbed up and dashed across it, climbed through a burning pig-pen, reached the street and stood in line for first aid. When he took off his clothes to receive first aid he noticed that the seat of his trousers showed two small burned holes.

The second difficulty is the desire of the Japanese to be polite and obliging. Rather than be impolite, their tendency is to say yes in answer to any question they do not fully understand.

The third problem is that many of the patients have no memory of immediate events as a result of concussion or psychic trauma. When questioned regarding the bomb they will say "a cloud rolled over their minds" and they remember nothing for a matter of hours or days.

The fourth source of difficulty has been the tendency to dramatize and give symbolic coloring to many of the happenings. Thus a number of the patients mentioned the disemboweling of bodies which is impossible as a blast effect, but might occur as a result of flying debris. The probability is that it has symbolic significance in relation to hara-kiri.

In spite of these difficulties we have had almost uniform cooperation from officials and civilians in attempting to gain the information we desired.

A. HIROSHIMA

HIROSHIMA was a city of some 300,000 to 350,000 inhabitants, situated on a low flat plain, partly delta of the OTAGAWA, partly made land. At a radius of about two kilometers from the hypocenter of the explosion the hills form a broken semicircular wall to the east, north, and west. A parade ground occupied about one-third of the central circle of one kilometer radius. (See Enclosure A.)

The bulk of the construction in the city was of one or two-story Japanese wooden houses with heavy tile roofs. The tile, about 2cm thick, is laid over several centimeters of clay. Scattered buildings were of modern fire-proof construction.

In general the streets were narrow and the houses closely packed.

On 6 August 1945, at 0814, just after the all clear air raid signal had been given, the first atomic bomb was dropped by parachute and exploded at a height estimated to be 570±15 meters. The hypocenter (the projection of the center on the earth) was at first thought to be about at the main south entrance to the parade ground, but was later shown to be about 150 meters south and west.

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 south-east 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

wooden framework, but has been greatly strengthened by the labor of our Brother Gropper as is frequently done in Japanese homes. Only along the front of the chapel which adjoins the house, have three supports given way (it has been made in manner of Japanese temple, entirely out of wood). Down in the valley, perhaps one kilometer toward the city from us, several peasant homes are on fire and the woods on the opposite side of the valley are aflame. A few of us go over to help control the flames. While we are attempting to put things in order, a storm comes up and it begins to rain. Over the city, clouds of smoke are rising and I hear a few slight explosions. I come to the conclusion that an incendiary bomb with an especially strong explosive action has gone off down in the valley. A few of us saw three planes at great altitude over the city at the time of the explosion. I, myself, saw no aircraft whatsoever.

Perhaps a half-hour after the explosion, a procession of people begins to stream up the valley from the city. The crowd thickens continuously. A few come up the road to our house. Their steps are dragging. Many are bleeding or have suffered burns. We give them first aid and bring them into the chapel, which we have in the meantime cleaned and cleared of wreckage, and put them to rest on the straw mats which constitute the floor of Japanese houses. A few display horrible wounds of the extremities and back. The small quantity of fat which we possessed during this time of war was soon used up in the care of the burns. Father Rektor who, before taking holy orders, had studied medicine, ministers to the injured, but our bandages and drugs are soon gone. We must be content with cleansing the wounds. More and more of the injured come to us. The least injured drag the more seriously wounded. There are wounded soldiers, and mothers carrying burned children in their arms. From the houses of the farmers in the valley comes word: "Our houses are full of wounded and dying. Can you help, at least by taking the worst cases?" The wounded come from the sections at the edge of the city. They saw the bright light, their houses collapsed and buried the inmates in their rooms. Those that were in the open suffered instantaneous burns, particularly on the lightly clothed or unclothed parts of the body. Numerous fires sprang up which soon consumed the entire district. We now conclude that the epicenter of the explosion was at the edge of the city near the JOKOGAWA Station, three kilometers away from us. We are concerned about Father Kopp who, that same morning, went to hold Mass at the Sisters of the Poor, who have a home for children at the edge of the city. He had not returned as yet.

Toward noon, our large chapel and library are filled with the seriously injured. The procession of refugees from the city continues. Finally, about one o'clock, Father Kopp returns together with the Sisters. Their house and the entire district where they live has burned to the ground. Father Kopp is bleeding about the head and neck, and he has a large burn on the right palm. He was standing in front of the nunnery ready to go home. All of a sudden, he became aware of the light, felt the wave of heat and a large blister formed on his hand. The windows were torn out by the blast. He thought that the bomb had fallen in his immediate vicinity. The nunnery, also a wooden structure made by our Brother Gropper, still remained but soon it is noted that the house is as good as lost because of fire, which had begun at many points in the neighborhood, sweeps closer and closer, and water is not available. There is still time to rescue certain things from the house and to bury them in an open spot. Then the house is swept by flame, and they fight their way back to us along the shore of the river and through the burning streets.

Soon comes news that the entire city has been destroyed by the explosion and that it is on fire. What became of Father Superior and the three Brothers who were at the center of the city at the Central Mission and Parish House? We had up to this time not given them a thought because we did not believe that the effects of the bomb encompassed the entire city. Also, we did not want to go into town except under pressure of dire necessity, because we thought that the population was greatly perturbed and that it might take revenge on any foreigners who they might consider spiteful onlookers of their misfortune, or even spies.

Brother Stolte and Brother Erlinghagen go down to the road which is still full of refugees and bring in the seriously injured who have sunken by the wayside, to the temporary aid station at the village school. There iodine is applied to the wounds but they are left uncleansed. Neither ointments nor other therapeutic agents are available. Those that have been brought in are laid on the floor and no one can give them any further care. What could one do when all means are lacking? Under these circumstances, it is almost useless to bring them in. Among the passers-by, there are many who are uninjured. In a purposeless, insensate manner, distraught by the magnitude of the disaster, most of them rush by and none conceives the thought of organizing help on his own initiative. They are concerned only with the welfare of their own families. It became clear to us during these days that the Japanese displayed little initiative, preparedness, and organizational skill in preparation for catastrophes. They despaired of any rescue work when something could have been saved by a cooperative effort, and fatalistically let the catastrophe take its course. When we urged them to take part in the rescue work, they did everything willingly, but on their own initiative they did very little.

At about four o'clock in the afternoon, a theology student and two kindergarten children, who lived at the Parish House in the city, come and report that the Church, Parish House and adjoining buildings had burned down, and that Father Superior LaSalle and Father Schiffer had been seriously injured and that they had taken refuge in ASANO Park on the River bank. It is obvious that we must bring them in since they are too weak to come here on foot.

Hurriedly, we get together two stretchers and seven of us rush toward the city. Father Rektor comes along with food and medicine. The closer we get to the city, the greater is the evidence of destruction and the more difficult is it to make our way. The Houses at the edge of the city are all severely damaged. Many have collapsed or burned down. Further in, almost all of the dwellings have been damaged by fire. Where the city stood, there is a gigantic burned-out scar. We make our way along the street on the river bank among the burning and smoking ruins. Twice we are forced into the river itself by the heat and smoke at the level of the street. Frightfully burned people beckon to us. Along the way, there are many dead and dying. On the MISASA Bridge, which leads into the inner city, we are met by a long procession of soldiers who have suffered burns. They drag themselves along with the help of staves or are carried by their less severely injured comrades.....an endless procession of the unfortunate. Abandoned on the bridge, there stand with sunken heads a number of horses with large burns on their flanks. On the far side, the cement structure of the local hospital is the only building that remains standing. Its interior, however, has been burned out. It acts as a landmark to guide us on our way. Finally we reach the entrance of the park. A large proportion of the populace has taken refuge there, but even the trees of the park are on fire in several places. Paths and bridges are blocked by trunks of fallen trees and are almost impassable. We are told that a high wind, which may well have resulted from the heat of the burning city, had uprooted the large trees. It is now quite dark. Only the fires, which are still raging in some places at a distance, give out a little light. At the far corner of the park, on the river bank itself, we at last come upon our colleagues. Father Schiffer is on the ground pale as a ghost. He has a deep incised wound behind the ear and has lost so much blood that we are concerned about his chances for survival. The Father Superior had suffered a deep wound of the lower leg. Father Gieslik and Father Kleinsorge have minor injuries but are completely exhausted.

While they are eating the food that we have brought along, they tell us of their experiences. They were in their rooms at the Parish House - it was quarter after eight, exactly the time when we had heard the explosion in NAGATSUKA - when came the intense light and immediately thereafter the sound of breaking windows, walls and furniture. They were showered with glass

splinters and fragments of wreckage. Father Schiffer was buried beneath a portion of a wall and suffered a severe head injury. The Father Superior received most of the splinters in his back and lower extremity from which he bled copiously. Everything was thrown about in the rooms themselves, but the wooden framework of the house remained intact. The solidity of the structure that was the work of Brother Gropper again shone forth. They had the same impression that we had in NAGATSUKA: that the bomb had burst in their immediate vicinity. The Church, school, and all buildings in the immediate vicinity collapsed at once. Beneath the ruins of the school, the children cried for help. They were freed with great effort. Several others were also rescued from the ruins of nearby dwellings. Even the Father Superior and Father Schiffer, despite their wounds, rendered aid to others and lost a great deal of blood in the process. In the meantime, fires which had begun some distance away are raging even closer, so that it becomes obvious that everything will soon burn down. Several objects are rescued from the Parish House and were buried in a clearing in front of the Church, but certain valuables and necessities which had been kept ready in case of fire could not be found on account of the confusion which had been wrought. It is high time to flee, since the oncoming flames leave almost no way open. FUKAI, the secretary of the Mission, is completely out of his mind. He does not want to leave the house and explains that he does not want to survive the destruction of his fatherland. He is completely uninjured. Father Kleinsorge drags him out of the house on his back and he is forcefully carried away. Beneath the wreckage of the houses along the way, many have been trapped and they scream to be rescued from the oncoming flames. They must be left to their fate. The way to the place in the city to which one desires to flee is no longer open and one must make for ASANO Park. FUKAI does not want to go further and remains behind. He has not been heard from since. In the park, we take refuge on the bank of the river. A very violent whirlwind now begins to uproot large trees, and lifts them high into the air. As it reaches the water, a water spout forms which is approximately 100 meters high. The violence of the storm luckily passes us by. Some distance away, however, where numerous refugees have taken shelter, many are blown into the river. Almost all who are in the vicinity have been injured and have lost relatives who have been pinned under the wreckage or who have been lost sight of during the flight. There is no help for the wounded and some die. No one pays any attention to a dead man lying nearby.

The transportation of our own wounded is difficult. It is not possible to dress their wounds properly in the darkness, and they bleed again upon slight motion. As we carry them on the shaky litters in the dark over the fallen trees of the park, they suffer unbearable pain as the result of the movement, and lose dangerously large quantities of blood. Our succoring angel in this difficult situation is an unknown Japanese Protestant pastor. He has brought up a boat and offers to take our wounded upstream to a place where progress is easier. First, we lower the litter containing Father Schiffer into the boat and two of us accompany him. We plan to bring the boat back for the Father Superior. The boat returns about one-half hour later and the pastor requests that several of us help in the rescue of two children whom he had seen in the river. We rescue them. They have severe burns. Soon they suffer chills and die in the park. The Father Superior is conveyed in the boat in the same manner as Father Schiffer. The theology student and myself accompany him. Father GIESLIK considers himself strong enough to make his way on foot to NAGATSUKA with the rest of us, but Father Kleinsorge cannot walk so far and we leave him behind and promise to come for him and the housekeeper tomorrow. From the other side of the stream comes the whinny of horses who are threatened by the fire. We land on a sand spit which juts out from the shore. It is full of wounded who have taken refuge there. They scream for aid for they are afraid of drowning as the river may rise with the sea, and cover the sand spit. They themselves are too weak to move. However, we must press on and finally we reach the spot where the group containing Father Schiffer is waiting. Here a rescue party had brought a large case of fresh rice cakes but there is no one to distribute them to the numerous wounded that lie all about. We distribute them to those that are nearby and also help ourselves. The wounded call

for water and we come to the aid of a few. Cries for help are heard from a distance, but we cannot approach the ruins from which they come. A troop of soldiers comes along the road and their officer notices that we speak a strange language. He at once draws his sword, screamingly demands who we are and threatens to cut us down. Father Laures, Jr., seizes his arm and explains that we are German. We finally quiet him down. He thought that we might well be Americans who had parachuted down. Rumors of parachutists were being bandied about the city. The Father Superior, who was clothed only in a shirt and trousers, complains of feeling freezing cold, despite the warm summer night and the heat of the burning city. The one man among us who possesses a coat gives it to him and, in addition, I give him my own shirt. To me, it seems more comfortable to be without a shirt in the heat.

In the meantime, it has become midnight. Since there are not enough of us to man both litters with four strong bearers, we determine to remove Father Schiffer first to the outskirts of the city. From there, another group of bearers is to take over to NAGATSUKA; the others are to turn back in order to rescue the Father Superior. I am one of the bearers. A theology student goes in front to warn us of the numerous wires, beams and fragments of ruins which block the way and which are impossible to see in the dark. Despite all precautions, our progress is stumbling and our feet get tangled in the wire. Father Kruer falls and carries the litter with him. Father Schiffer becomes half unconscious from the fall and vomits. We pass an injured man who sits all alone among the hot ruins and whom I had seen previously on the way down. On the MISASA Bridge, we meet Father Tappe and Father Luhmer, who have come to meet us from NAGATSUKA. They had dug a family out of the ruins of their collapsed house some fifty meters off the road. The father of the family was already dead. They had dragged out two little girls and placed them by the side of the road. Their mother was still trapped under some beams. They had planned to complete the rescue and then to press on to meet us. At the outskirts of the city, we put down the litter and leave two men to wait until those who are to come from NAGATSUKA appear. The rest of us turn back to fetch the Father Superior. Most of the ruins have now burned down. The darkness kindly hides the many forms that lie on the ground. Only occasionally in our quick progress do we hear calls for help. One of us remarks that the remarkable burned smell reminds him of incinerated corpses. The upright, squatting form which we had passed by previously is still there. Transportation on the litter, which has been constructed out of boards, must be very painful to the Father Superior, whose entire back is full of fragments of glass. In a narrow passage at the edge of town, a car forces us to the edge of the road. The litter bearers on the left side fall into a two meter deep ditch which they could not see in the darkness. Father Superior hides his pain with a dry joke, but the litter which is now no longer in one piece cannot be carried further. We decide to wait until Brother KINJO can bring a hand cart from NAGATSUKA. He soon comes back with one that he has requisitioned from a collapsed house. We place Father Superior on the cart and wheel him the rest of the way, avoiding as much as possible the deeper pits in the road. About half past four in the morning, we finally arrive at the Novitiate. Our rescue expedition had taken almost 12 hours. Normally, one could go back and forth to the city in two hours. Our two wounded were now, for the first time, properly dressed. I get two hours sleep on the floor; some one else has taken my own bed. Then I read a Mass in gratiarum actionem; it is the 7th of August, the anniversary of the foundation of our Society. Then we bestir ourselves to bring Father Kleinsorge and other acquaintances out of the city.

We take off again with the hand cart. The bright day now reveals the frightful picture which last night's darkness had partly concealed. Where the city stood, everything as far as the eye could reach, is a waste of ashes and ruin. Only several skeletons of buildings completely burned out in the interior remain. The banks of the river are covered with dead and wounded, and the rising waters have here and there covered some of the corpses. On the broad street in the HAKUSHIMA district, naked burned cadavers are particularly numerous. Among them are the wounded who still live. A few have crawled un-

der the burnt-out autos and trams. Frightfully injured forms beckon to us and then collapse. An old woman and a girl whom she is pulling along with her fall down at our feet. We place them on our cart and wheel them to the hospital at whose entrance a dressing station has been set up. Here the wounded lie on the hard floor, row on row. Only the largest wounds are carefully dressed. We convey another soldier and an old woman to this place but we cannot move everybody who lies exposed in the sun. It would be endless and it is questionable whether those whom we can drag to the dressing station can come out alive, because even here nothing really effective can be done. Later, we ascertain that the wounded lay for days in the burnt-out hallways of the hospital and there they died. We must proceed to our goal in the park and are forced to leave the wounded to their fate. We make our way to the place where our Church stood to dig up those few belongings that we had buried yesterday. We find them intact. Everything else has been completely burned. In the ashes, we find a few molten remnants of the holy vessels. At the park, we load the housekeeper and a mother with her two children on the cart. Father Kleinsorge feels strong enough, with the aid of Brother NOBUHARA, to make his way home on foot. The way back takes us once again past the dead and wounded in HAKUSHIMA. Again no rescue parties are in evidence. At the MISASA Bridge, there still lies the family which Fathers Tappe and Luhmer had yesterday rescued from the ruins. A piece of tin had been placed over them to shield them from the sun. We cannot take them along for our cart is full. We give them and those nearby water to drink and decide to rescue them later. At three o'clock in the afternoon, we are back in NAGATSUKA.

After we have had a few swallows and a little food, Fathers Stolte, Luhmer, Erlinghagen and myself, take off once again to bring in the family. Father Kleinsorge requests that we also rescue two children who had lost their mother and who had lain near him in the park. On the way, we were greeted by strangers who had noted that we were on a mission of mercy and who praised our efforts. We now met groups of individuals who were carrying the wounded about on litters. As we arrived at the MISASA Bridge, the family that had been there was gone. They might well have been borne away in the meantime. There was a group of soldiers at work taking away those that had been sacrificed yesterday. More than 30 hours had gone by until the first official rescue party had appeared on the scene. We find both children and take them out of the park: a six-year old girl who was uninjured, and a twelve-year old girl who had been burned about the head, hands and legs, and who had lain for thirty hours without care in the park. The left side of her face and the left eye were completely covered with blood and pus, so that we thought that she had lost the eye. When the wound was later washed, we noted that the eye was intact and that the lids had just become stuck together. On the way home, we took another group of three refugees with us. They first wanted to know, however, of what nationality we were. They, too, feared that we might be Americans who had parachuted in. When we arrived in NAGATSUKA, it had just become dark.

We took under our care 50 refugees who had lost their all. The majority of them were wounded and not a few had dangerous burns. Father Rektor treated the wounds as well as he could with the few medicaments that we could, with effort, gather up. He had to confine himself in general to cleansing the wounds of purulent material. Even those with the smaller burns are very weak and all suffered from diarrhea. In the farm houses in the vicinity, almost everywhere there were also wounded. Father Rektor made daily rounds and acted in the capacity of a painstaking physician and was a great Samaritan. Our work was, in the eyes of the people, a greater boost for Christianity than all our efforts during the preceding long years. Three of the severely burned in our house died within the next few days. Suddenly the pulse and respiration ceased. It is certainly a sign of our good care that so few died. In the official aid stations and hospitals, a good third or half of those that had been brought in died. They lay about there almost without care, and a very high percentage succumbed. Everything was lacking: doctors, assistants, dressings, drugs, etc. In an aid station at a school at a nearby village, a

group of soldiers for several days did nothing except to bring in and cremate the dead behind the school.

During the next few days, funeral processions passed our house from morning to night, bringing the deceased to a small valley nearby. There, in six places, the dead were burned. People brought their own wood and themselves did the cremation. Father Luhmer and Father Laures found a dead man in a nearby house who had already become bloated and who emitted a frightful odor. They brought him to this valley and incinerated him themselves. Even late at night, the little valley was lit up by the funeral pyres.

We made systematic efforts to trace our acquaintances and the families of the refugees whom we had sheltered. Frequently, after the passage of several weeks, some one was found in a distant village or hospital but of many there was no news, and these were apparently dead. We were lucky to discover the mother of the two children whom we had found in the park and who had been given up for dead. After three weeks, she saw her children once again. In the great joy of the reunion were mingled the tears for those whom we shall not see again.

The magnitude of the disaster that befell HIROSHIMA on August 6th was only slowly pieced together in my mind. I lived through the catastrophe and saw it only in flashes, which only gradually were merged to give me a total picture. What actually happened simultaneously in the city as a whole is as follows: As a result of the explosion of the bomb at 8:15, almost the entire city was destroyed at a single blow. Only small outlying districts in the southern and eastern parts of the town escaped complete destruction. The bomb exploded over the center of the city. As a result of the blast, the small Japanese houses in a diameter of five kilometers, which comprised 99 per cent of the city, collapsed or were blown up. Those who were in the houses were buried in the ruins. Those who were in the open sustained burns resulting from contact with the substance or rays emitted by the bomb. Where the substance struck in quantity, fires sprang up. These spread rapidly. The heat which rose from the center created a whirlwind which was effective in spreading fire throughout the whole city. Those who had been caught beneath the ruins and who could not be freed rapidly, and those who had been cut off by the flames, became casualties. As much as six kilometers from the center of the explosion, all houses were damaged and many collapsed and caught fire. Even fifteen kilometers away, windows were broken. It was rumored that the enemy fliers had first spread an explosive and incendiary material over the city and then had created the explosion and ignition. A few maintained that they saw the planes drop a parachute which had carried something that exploded at a height of 1,000 meters. The newspapers called the bomb an "atomic bomb" and noted that the force of the blast had resulted from the explosion of uranium atoms, and that gamma rays had been sent out as a result of this, but no one knew anything for certain concerning the nature of the bomb.

How many people were a sacrifice to this bomb? Those who had lived through the catastrophe placed the number of the dead at at least 100,000. HIROSHIMA had a population of 400,000. Official statistics place the number who had died at 70,000 up to September 1st, not counting the missing....and 130,000 wounded, among them 43,500 severely wounded. Estimates made by ourselves on the basis of groups known to us show that the number of 100,000 dead is not too high. Near us there are two barracks, in each of which forty Korean workers lived. On the day of the explosion, they were laboring on the streets of HIROSHIMA. Four returned alive to one barracks and sixteen to the other. Six hundred students of the Protestant Girls' School worked in a factory, from which only thirty to forty returned. Most of the peasant families in the neighborhood lost one or more of their members who had worked at factories in the city. Our next door neighbor, TAMURA, lost two children and himself suffered a large wound since, as it happened, he had been in the city on that day. The family of our reader suffered two dead, father and son; thus a family of five members suffered at least two losses, counting only the dead

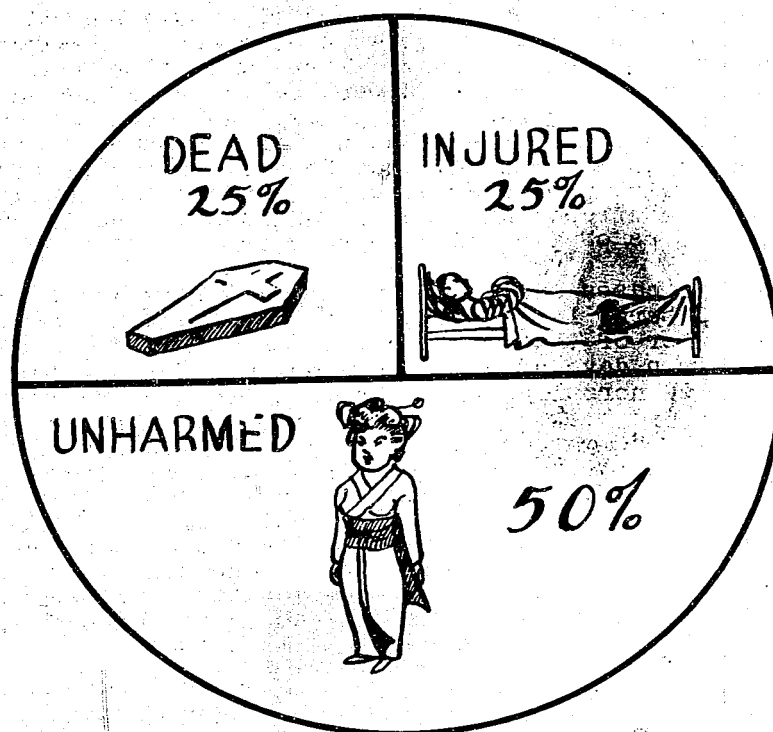
and severely wounded. There died the Mayor, the President of the central Japan district, the Commander of the city, a Korean prince who had been stationed in HIROSHIMA in the capacity of an officer, and many other high-ranking officers. Of the professors of the University, thirty-two were killed or severely injured. Especially hard hit were the soldiers. The Pioneer Regiment was almost entirely wiped out. The barracks were near the center of the explosion.

Thousands of wounded who died later could doubtless have been rescued had they received proper treatment and care, but rescue work in a catastrophe of this magnitude had not been envisioned; since the whole city had been knocked out at a blow, everything which had been prepared for emergency work was lost, and no preparation had been made for rescue work in the outlying districts. Many of the wounded also died because they had been weakened by undernourishment and consequently lacked in strength to recover. Those who had their normal strength and who received good care slowly healed the burns which had been occasioned by the bomb. There were also cases, however, whose prognosis seemed good but who died suddenly. There were also some who had only small external wounds who died within a week or later, after an inflammation of the pharynx and oral cavity had taken place. We thought at first that this was the result of inhalation of the substance of the bomb. Later, a commission established the thesis that gamma rays had been given out at the time of the explosion, following which the internal organs had been injured in a manner resembling that consequent upon Roentgen irradiation. This produces a diminution in the numbers of the white corpuscles.

Only several cases are known to me personally where individuals who did not have external burns later died. Father Kleinsorge and Father Gieslik, who were near the center of the explosion, but who did not suffer burns became quite weak some fourteen days after the explosion. Up to this time small incised wounds had healed normally, but thereafter the wounds which were still unhealed became worse and are to date (in September) still incompletely healed. The attending physician demonstrated a leucopenia. There thus seems to be some truth in the statement that the radiation had some effect on the blood. I am of the opinion, however, that their generally undernourished and weakened condition was partly responsible for these findings. It was also noised about that the ruins of the city emitted deadly rays and that many workers who went there to aid in the clearing died, and that the central district would be uninhabitable for some time to come. I have my doubts as to whether such talk is true and myself and others who worked in the ruined area for some hours shortly after the explosion suffered no such ill effects.

None of us in those days heard a single outburst against the Americans on the part of the Japanese, nor was there any evidence of a vengeful spirit. The Japanese suffered this terrible blow as a part of the fortunes of war.....something to be borne without complaint. During this war, I have noted relatively little hatred toward the Allies on the part of the people themselves, although the press has taken occasion to stir up such feelings. After the victories at the beginning of the war, the enemy was rather looked down upon, but when the Allied offensive gathered momentum and especially after the advent of the majestic B-29's, the technical skill of America became an object of wonder and admiration. The following anecdote indicates the spirit of the Japanese: A few days after the atomic bombing, the secretary of the University came to us asserting that the Japanese were ready to destroy San Francisco by means of an equally effective bomb. It is dubious that he himself believed what he told us. He merely wanted to impress upon us foreigners that the Japanese were capable of similar discoveries. In his nationalistic pride, he talked himself into believing this. The Japanese also intimated that the principle of the new bomb was a Japanese discovery. It was only lack of raw materials, they said, which prevented its construction. In the meantime, the Germans were said to have carried the discovery to a further stage and were about to initiate such bombing. The Americans were reputed to have learned the secret from the Germans, and they had then brought the bomb to a stage of industrial completion.

GRAPH I
DISTRIBUTION OF CASUALTIES
HIROSHIMA



We have discussed among ourselves the ethics of the use of the bomb. Some consider it in the same category as poison gas and were against its use on a civil population. Others were of the view that in total war, as carried on in Japan, there was no difference between civilians and soldiers, and that the bomb itself was an effective force tending to end the bloodshed, warning Japan to surrender and thus to avoid total destruction. It seems logical to me that he who supports total war in principle cannot complain of a war against civilians. The crux of the matter is whether total war in its present form is justifiable, even when it serves a just purpose. Does it not have material and spiritual evil as its consequences which far exceed whatever the good that might result? When will our moralist give us a clear answer to this question?

* * * * *

To return to more scientific aspects: The bomb detonated at a height of about 550 to 600 meters. One apparently accurate measurement is 570 ± 15 meters. Neutrons and rays of practically the entire electromagnetic spectrum were probably liberated. Effects on personnel were produced by heat rays, ultraviolet rays, gamma rays and, it is believed, neutrons. It is suggested by outlines of shadows that in the instant before complete disintegration the exploding bomb expanded to a "fire-ball" about 100 meters in diameter.

The population of HIROSHIMA at the time of the bomb, has been variably estimated to be between 300,000 and 350,000. We have chosen 320,000 as a fair figure. Enclosure (B), obtained from USSBS, gives the disposition and number of military personnel in the city, as well as the casualties they suffered. Military casualties were much less than civilian, due to better protection and better discipline.

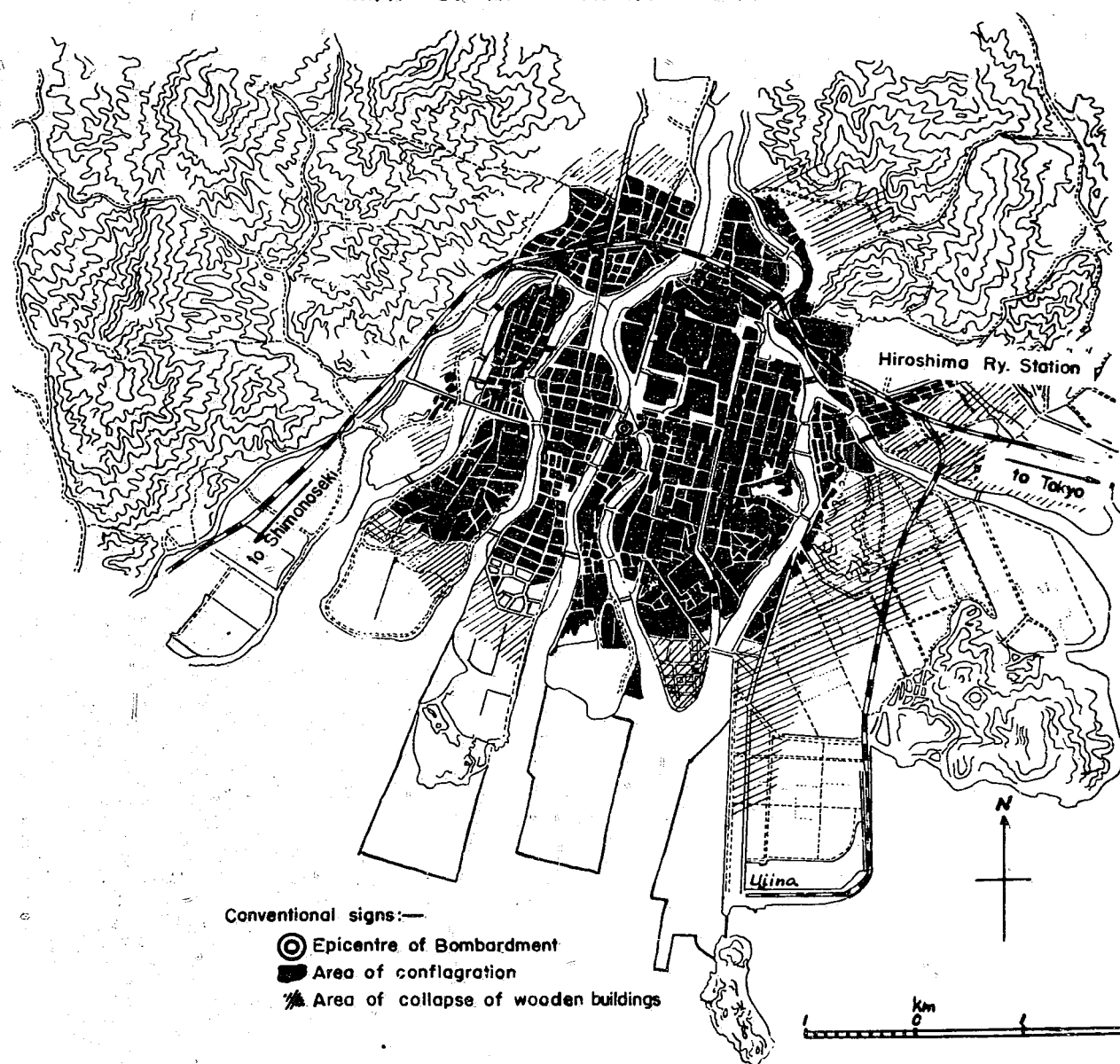
We estimate a total of 80,000 were killed. Japanese figures range from 60,000 to 120,000. Approximately 80,000 were seriously wounded or burned. Graph 1 shows the proportion of casualties. Some estimates of casualties, believed exaggerated, reach 275,000.

The vast majority of deaths occurred from fire, injury by flying or falling debris, or violent displacement by blast. Some reports exist of early death presumably due to gamma rays or neutrons, since such persons died without evidence of external injury and showed symptoms compatible with radiation sickness. Such cases will be considered in a later section of the report.

Detailed figures as to types of injury of survivors will be obtainable later, when statistical analysis has been made of the data on approximately 7000 survivors questioned by the U.S. Army group of the Joint Atomic Bomb Investigation Commission. A sample of 4030 cases was studied to show types of injury. The results are shown in Graph 2. These 4030 survivors picked at random showed 23% healthy, 29% suffering from flesh burn, 33% suffering from injury by blast, and 15% with radiation sickness.

The extents of the areas of devastation by fire and blast are shown on Figure 1. This map, prepared by Professor KONDO of Kyoto Imperial University, reveals that the blast collapsed buildings over an area of 20 square kilometers, and fire swept 12 square kilometers. Eighty thousand houses were destroyed. Most earthquake-proof structures stood, but most were burned out.

FIG. I
MAP OF HIROSHIMA CITY



SECRET

X-28-1



Figure 2

AREA OF DEVASTATION IN BUSINESS SECTION



Figure 3
TYPICAL SCENE LOOKING NORTH TOWARD HYPOCENTER

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

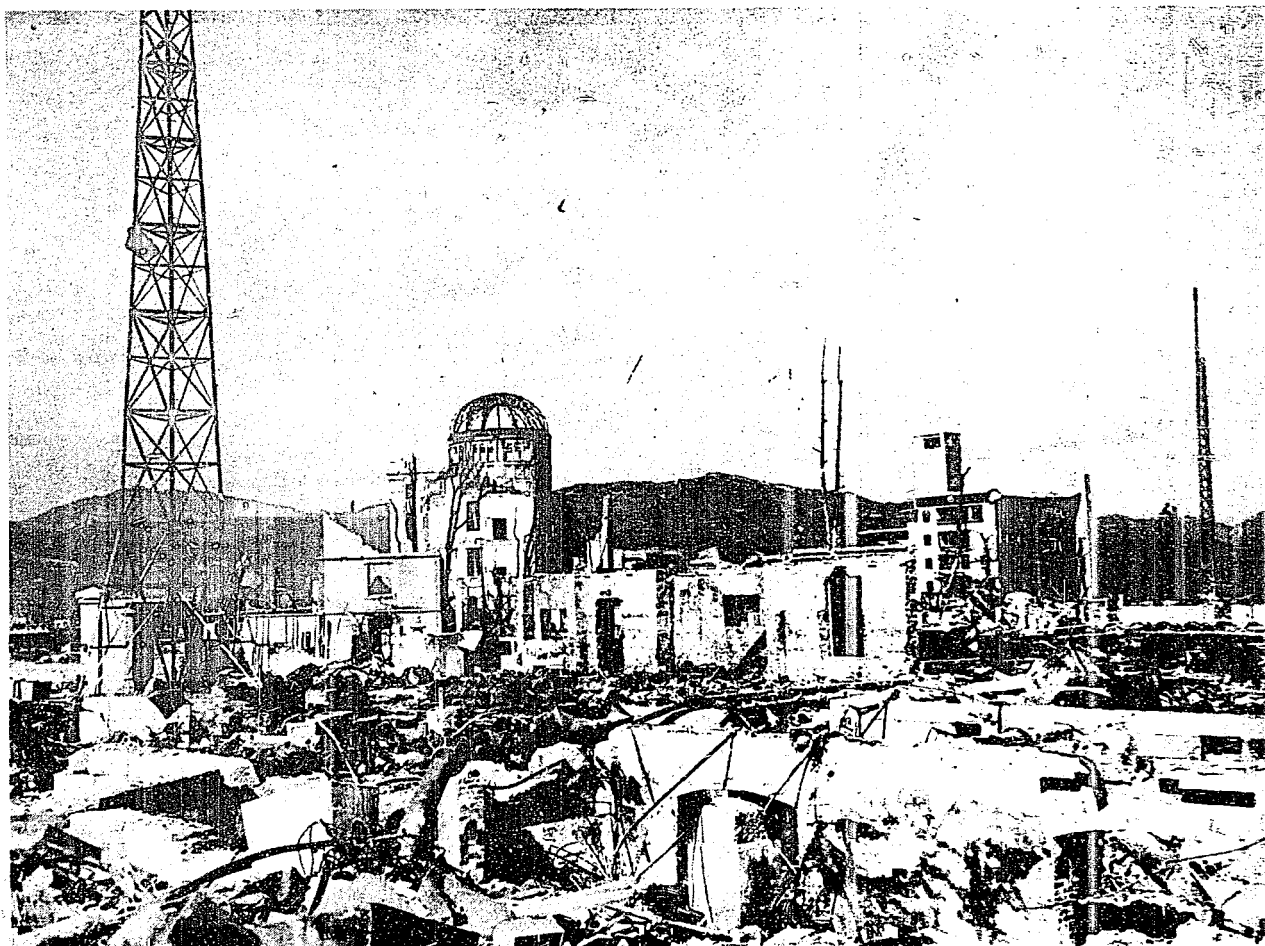


Figure 4
VIEW NEAR HYPOCENTER

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.

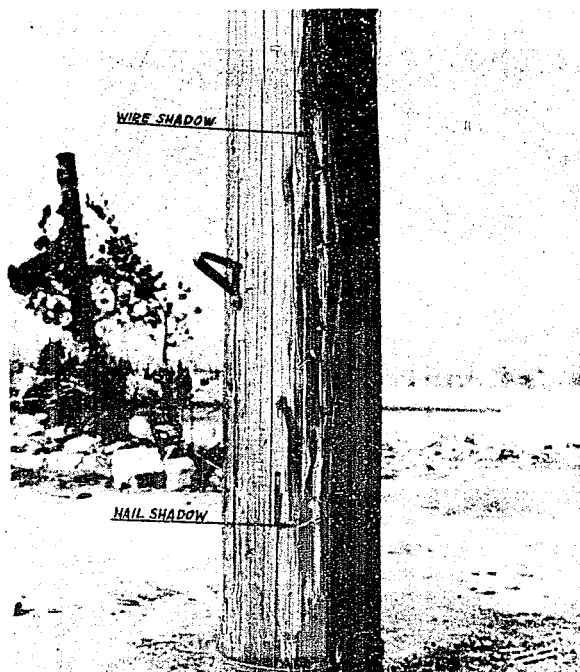
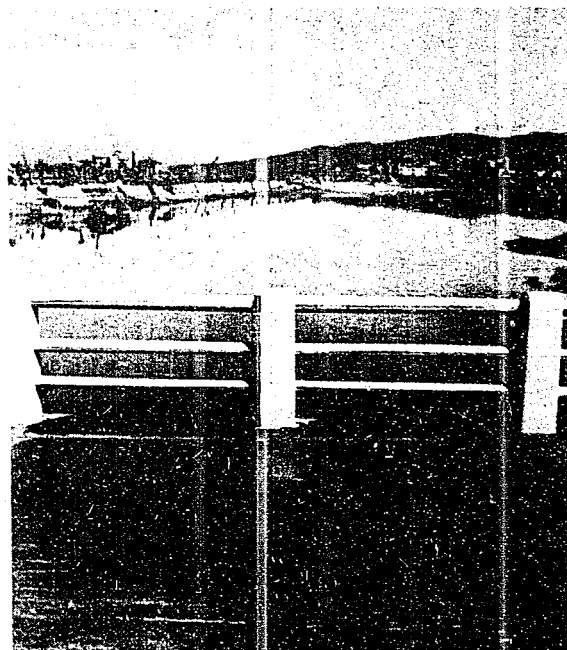


Figure 7

"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 ROAD-WAY



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

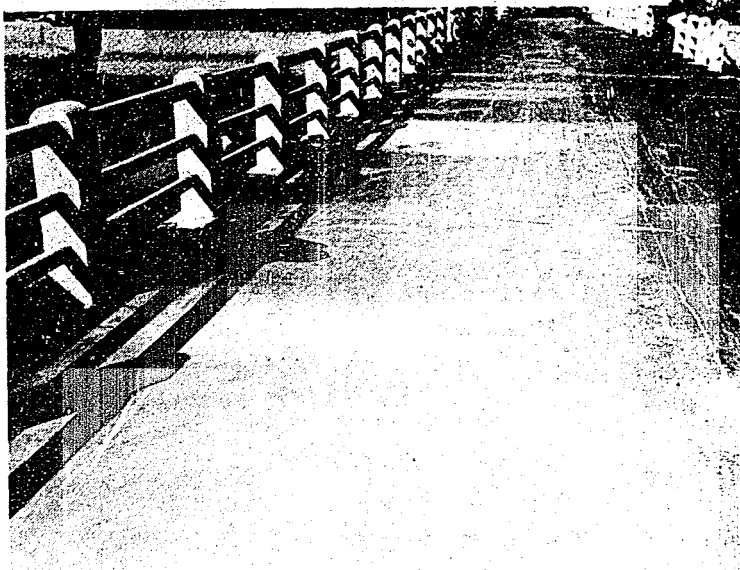
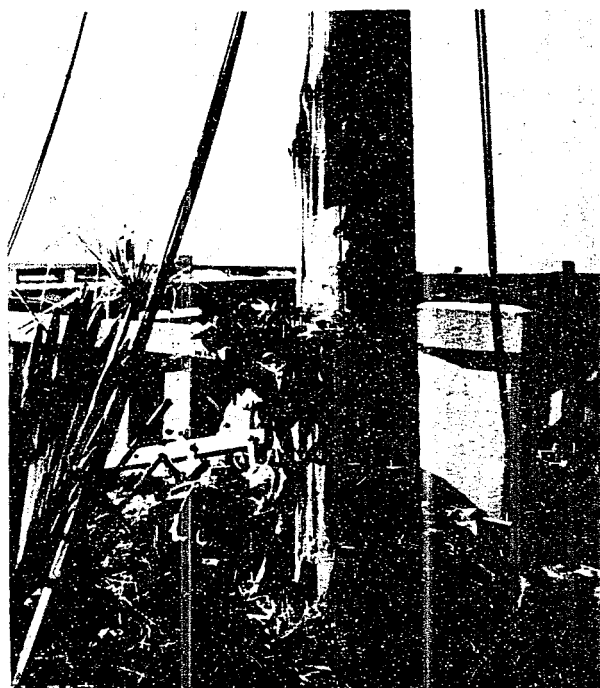
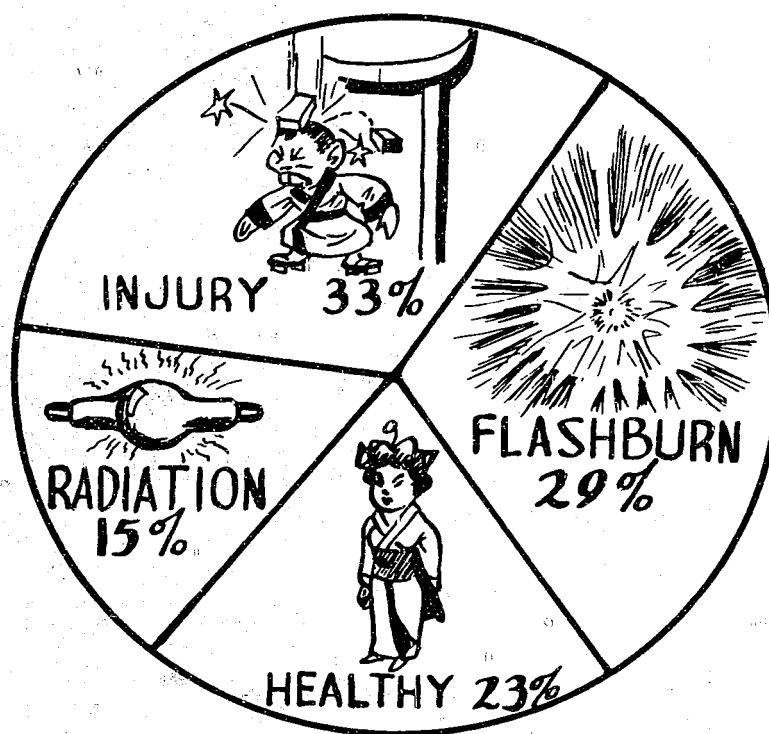


Figure 10
"SHADOW" OF MAN WALKING
(foreground) and (just beyond)
that of cart and man pulling it

GRAPH 2
EFFECT UPON SURVIVORS
(Sample of 4030)
HIROSHIMA



When one considers that the blast dislodging the leaf probably followed within a second after the explosion, the short time in which the exposed surface of the pole was carbonized can be appreciated.

The force of the blast has been estimated at about $1\text{kg}/\text{cm}^2$ at the hypocenter, and about $0.35\text{kg}/\text{cm}^2$ at 500 meters from the hypocenter.

The total energy released by the explosion was estimated at 10^{22} ergs by K. SASSO. Y. SUGE estimated the heat received on earth at 10^{12} calories.

Probably few slow neutrons reached the earth, as most of them would be absorbed by the nitrogen of the air, giving off gamma rays in the process of absorption.

Judging from the casualties, the total gamma, neutron and other biologically effective radiation was 500 r. or more at 1km from the hypocenter.

In many of the concrete buildings near the center, many escaped initial injury from blast or fire, but practically all died as a result of radiation sickness. This is at first difficult to understand, until one remembers that radiation entering through a window or other opening will strike floor and walls and induce much secondary radiation. In the Bankers' Club Building, studied very carefully by the Army Medical Group, Lt. Col. Liebow, AUS, found that all survivors of the initial heat and trauma of the explosion died later of radiation reaction, due in large part to scattered rays of secondary type.

Ultraviolet radiation was present, but could not be regarded as of significance in the production of casualties. Many people mentioned conjunctivitis as a prominent symptom, but this could have been due to dust, fumes, and other factors as well as ultraviolet light.

The flash burns were in large part caused by infra-red radiation from the explosion, rather than from heated air. Practically all survivors describe the light and sensation of heat as simultaneous, and the physical evidence further bears out this interpretation.

In a random sampling of 4030 survivors of HIROSHIMA, 23 percent were found healthy, 29 percent suffered from flash burn, 33 percent from physical injury and 15 percent from radiation. This is illustrated in Graph 2. This proportion of healthy persons (23 percent) suggests that perhaps the proportion given for total population of HIROSHIMA who were unharmed (50 percent) may be too high.

There is of course some overlapping of types of injury, but this cannot be determined exactly until the final calculations are made.

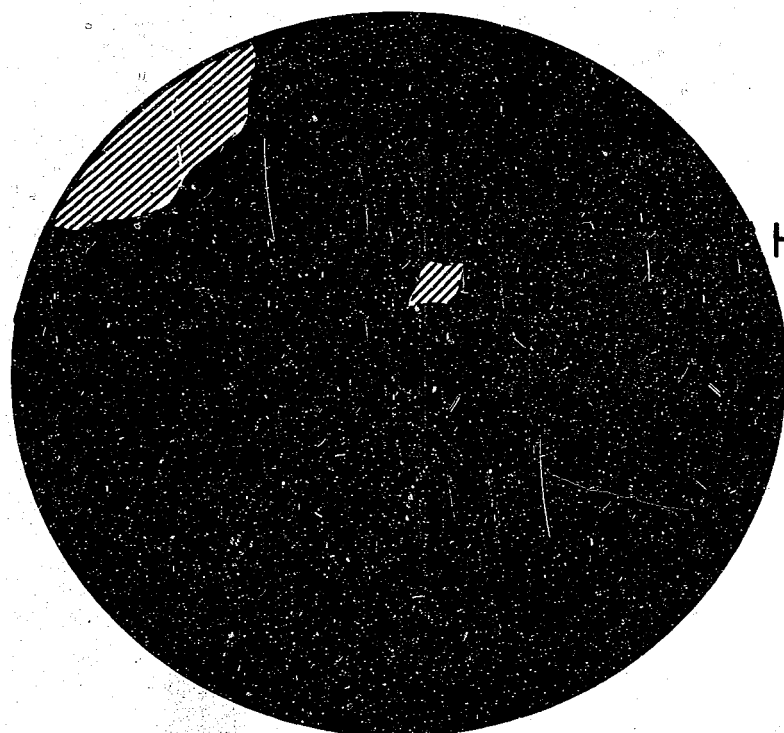
Evidence of secondary radiation burns

Two employees of Domei-tsushi Hiroshima, according to Dr. ASADA, suffered severe burns of the hands from aluminum cooking pots, while receiving flash burns of less severity to other exposed areas. The employees were close to a window in a concrete building near the hypocenter. Prof. TSUZUKI cites the experience of an employee of the Mitsubishi Works, whose skin was burned severely in the region of a metallic (silver or aluminum) cigarette case in his pocket.

Radioactive aluminum of a very low order of intensity (twice background) was found 500 meters from the hypocenter by ARAKATSU on August 15. It had a half-life of 15.5 hours, and hence might well have been sufficiently highly active at the time of the explosion to have produced severe radiation burns of nearby human tissues.

GRAPH 3

POPULATION DENSITY IN 2 KM. RADIUS



HIROSHIMA

 SPARSE DENSE

NAGASKI



B. NAGASAKI

NAGASAKI spreads about its harbor, its growth checked and funneled by the surrounding hills. The bulk of the city spreads out north and east of the head of the harbor, with a sprawling arm spread along a northerly valley. It was over this northerly arm of the city that the atomic bomb exploded. The slopes of the hills are very steep and only lightly inhabited.

On 9 August 1945, two B29's were reported over the SHIMBARA Peninsula at 10:53 A.M. At 11:00 A.M. the lead plane came over NAGASAKI from the east at 9000 meters and dropped three objects, each on a parachute.

We recovered one of these objects with the aid of G-2, Fifth Marine Division, and it proved to be largely a barometric device.

The second B29 came in at the same altitude and on the same course and at 11:02 dropped one atomic bomb, which detonated 40 seconds later at a height of 490±15 meters. The weather had been clear and dry for some days. There was a moderate overcast above the city, broken in the northerly portion. There was a light westerly wind.

The hypocenter of the bomb was near 170 MATSUYAMA Cho. Enclosure (C) is a map of the city with hypocenter of the explosion shown, a radial scale of distances from the hypocenter, and the coordinates used to locate the position of survivors. The scale of this map is not exact, as most maps made by the Japanese falsify the scale at various points. Enclosure (D), however, prepared for NavTechJap by the Mapping, Relief Mapping and Reproduction Centers of the Second Marine Division, is accurately scaled in the heavily damaged area. This is the only accurate map of the damage center known to exist.

In examining either of these maps it will be noted that the populated area within the effective range of the bomb is a narrow strip between irregular, steep, and almost uninhabited hills. Graph 3 contrasts the populated areas of HIROSHIMA and NAGASAKI with reference to the bomb centers.

The large proportion of the effective force of the NAGASAKI bomb wasted on rice-fields, bamboo groves, woods and open land is well brought out. This accounts for the fact that although the NAGASAKI bomb was more powerful than that dropped at HIROSHIMA, the casualties were far fewer and the physical damage less.

Several eyewitness stories of the NAGASAKI bomb explosion follow:

Dr. KOYANO: "I was in the polyclinic room of the hospital, surrounded by concrete walls. I was fully clothed, with a white laboratory coat and a white shirt. Just after eleven o'clock I saw a whitish yellow brilliant light and heard a dull roar simultaneously. Immediately I felt as though enveloped in hot gas, and choked for breath. Then I lost consciousness briefly. When I recovered there was fire and confusion."

Lt. S. IKURA: "I was four kilometers from the center at the base of the medical harbor guard. A bright, instantaneous flash, followed by a low thunderous roar and a great rush of wind, surrounded me. As the ceiling fell and glass splintered from the window, I felt a wave of heat. I went to the roof and looked out, taking a movie camera with me and exposing the film to a slowly rising column of smoke and dust to the north, that spread as it rose. Soon fire broke out in scattered spots."

H. KANAZAWA: "I was working with my brother in an open space about two kilometers from the prison and we were just getting hungry. Two planes had passed by and suddenly there was a blinding flash. We heard bang! and fell as a hot wind rushed past and when I got up my back had

many small cuts through my clothes. My neck and hands began to burn. All was dark with smoke, dust and flying buildings. Afterwards the house in which I lived was burned down."

The descriptions in general agree with those given by survivors at HIROSHIMA. The NAGASAKI bomb gives evidence of being the more powerful of the two, but its radiation effect was essentially similar to that dropped on HIROSHIMA.

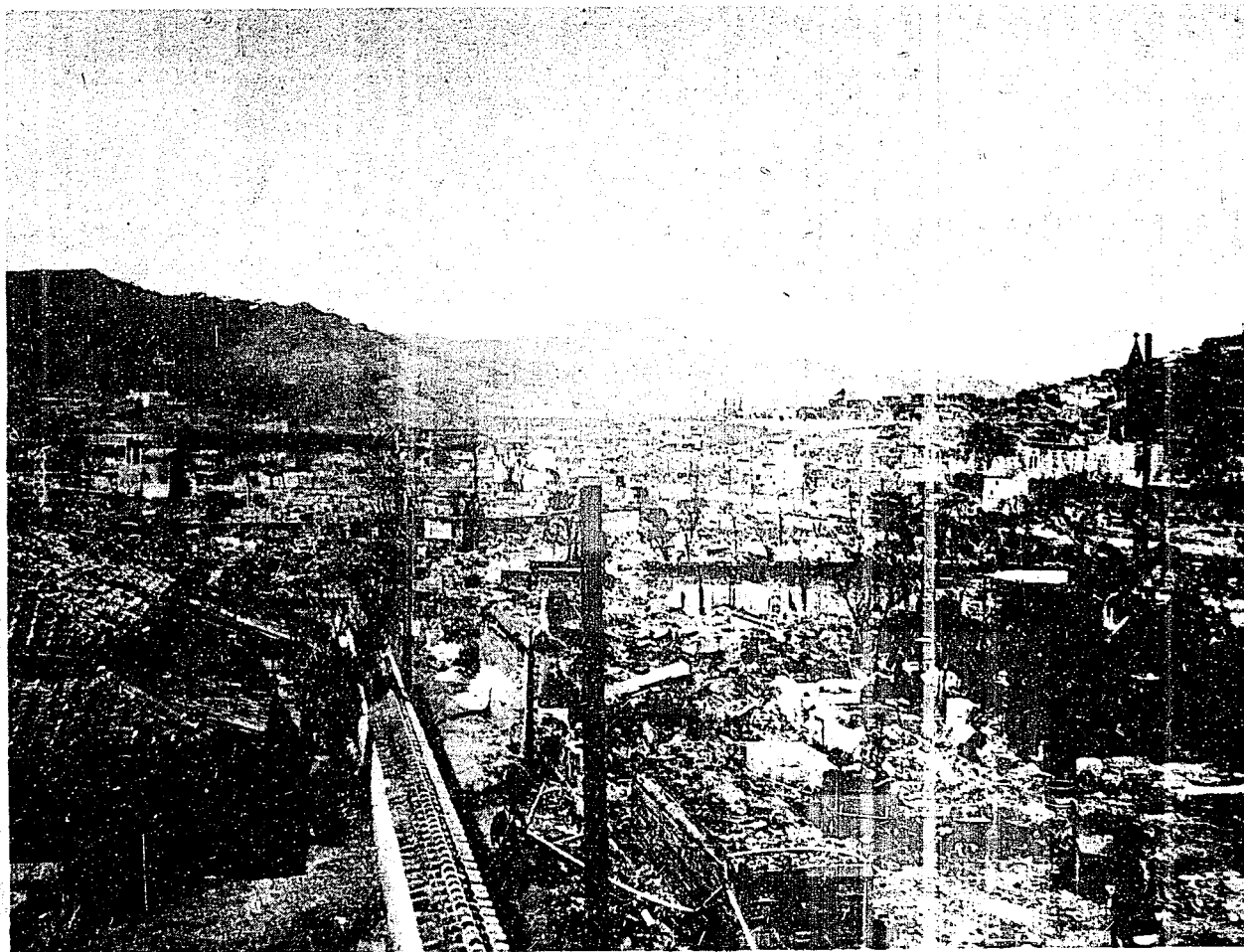


Figure 11

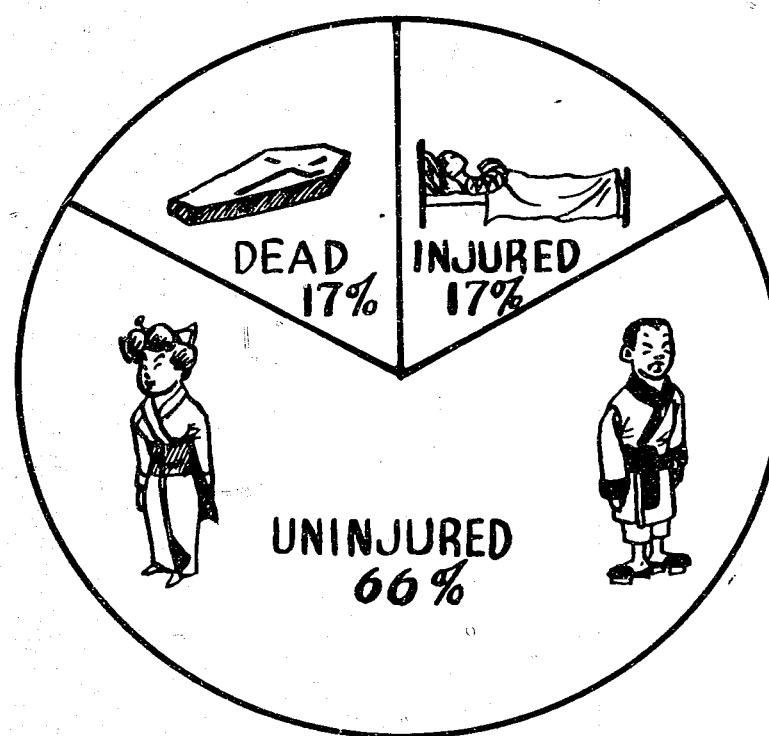
BOMBED AREA AT NAGASAKI

Looking north from Shinkozen Hospital

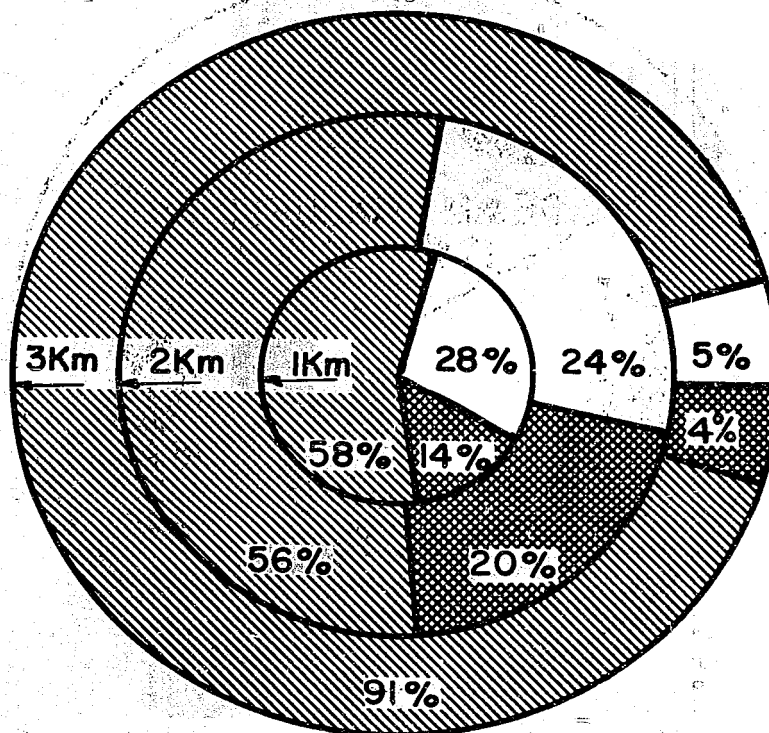
Dr. NISHINA and his associates estimate a blast pressure of $11/\text{kg}/\text{cm}^2$ at 200 meters from the hypocenter, falling to $1.5/\text{kg}$ at 300 meters, $0.55/\text{kg}$ at 500 meters, and $0.30/\text{kg}$ at one kilometer. The total energy was estimated as twice that at HIROSHIMA.

The area of total destruction by blast was 4.7 km^2 ; the burned area was 20 km^2 . It will be noted that the secondary fire area extended well beyond the blast area, which is the reverse of the case at HIROSHIMA.

GRAPH 4
EFFECTS UPON TOTAL POPULATION
NAGASKI

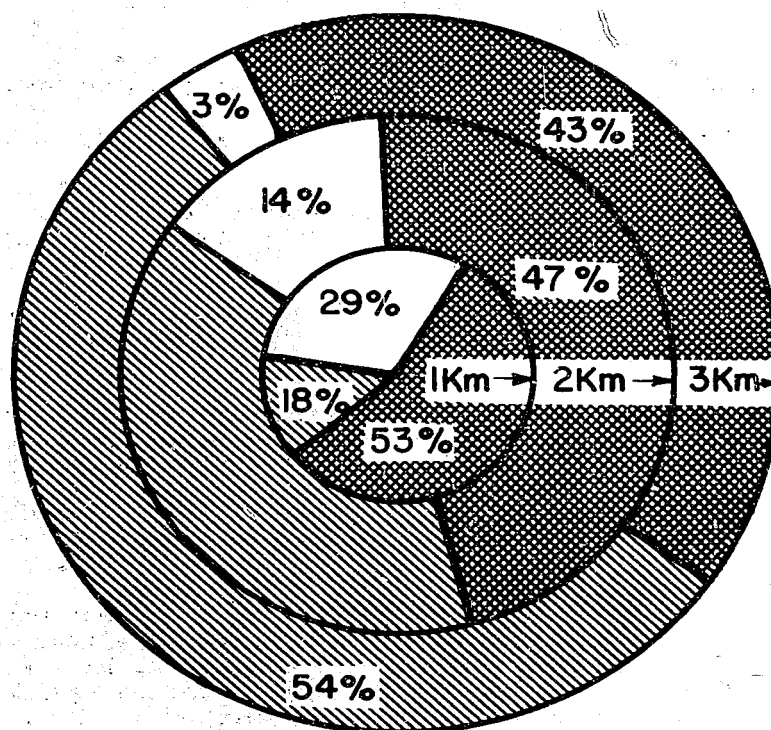


GRAPH 5
EFFECT UPON PERSONS SHELTERED
BY CONCRETE BUILDINGS
(Sample on 2182 survivors)
NAGASAKI



■ 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 |
| Census, 1 Nov. 1945* | 69,789 | 72,959 | 260,000+ |
| Rice Rationing, Computed for 1 Nov. 1945 | | | 142,748 |
| | | | 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 1 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.

In a further attempt to evaluate casualty statistics furnished by the Japanese authorities payroll figures of employees injured and killed were obtained for principal factories. These are summarized, among other items, in Enclosure (F). Approximately 12 percent of these employees were killed, but no figures are given for the number who were working underground or were in shelters at the time of the explosion.

Changes in the school population give a further check on casualties, but are not of much help, since the children worked during the week and were not in the school buildings at the time of the raid. Enclosure (G) is a map showing the Nagasaki School Districts, and Enclosure (H) the pre-raid and post-raid attendance figures and estimates of deaths and injury. As will be seen, these figures do not check satisfactorily, and the prefectural estimate is probably highly inaccurate. If the school children (17 percent of the population) suffered in proportion to the general population, there would have been 7650 killed and an equal number injured. However, since many worked in distant fields, this estimate may be too high.

C. Effects of the Radiations on the Human Body.

The most distinctive features of the atomic bomb explosions are the changes produced in the human body. The radiation reactions are similar at HIROSHIMA and at NAGASAKI, and hence will be described jointly. The reactions are what could be expected from a single dose of radiation to the entire body, varying with distance and protection of personnel from lethal to minimal.

Since the wave-length of the radiation is unknown, no set dosage can be estimated. Let us assume that the average wave-length approached that produced by 150,000 to 200,000 volt X-rays. In this case, about 500 r. total body radiation would be lethal within 48 or 72 hours; 350 r. would cause delayed skin reaction with or without hair loss, combined with blood and bone marrow changes; and as little as 50 r. would probably have no effect. Gastro-intestinal symptoms might be prominent.

The early newspaper accounts mentioned apparently uninjured persons dying a day or two after the explosions. This is confirmed by medical observers, and undoubtedly represents those who received a lethal dose of radiation. The mechanism of death in such cases is not clearly defined. Injury to the more susceptible blood, bone marrow, and lymph node cells with attendant poisoning of the body by the products of protein breakdown within the killed and injured cells is probably an important factor. Disturbance of endocrine glands, particularly the adrenal cortex, may also be important. Persons dying in this stage may have felt only weakness and nausea. High fever was a frequent occurrence. Apparently no autopsies were done at this stage.

Those patients who received a lesser amount of radiation, but still of lethal amount, and many of those receiving smaller and sub-lethal amounts, noticed symptoms of radiation sickness similar to but more severe than those of patients who react to therapeutic X-ray treatment by weakness, nausea, vomiting, loss of appetite, and sometimes diarrhea. Such reactions may be immediate or delayed for several days or, rarely, even two to three weeks. Diarrhea may be mild or severe, watery or bloody. Diarrhea due to radiation sickness is difficult to distinguish from bacillary dysentery or typhoid fever, but the course of the disease usually clarifies the diagnosis.

Let K. MURATA describe his symptoms: "We three were very fortunate as we did not receive a single scratch though we were sitting in the open when the bomb went "flash" and then "bang!" But many living in NAGASAKI are dying. I was caught in the second stage of this bomb disease. There were no doctors, no medicines, and the house was torn up like outdoors. I had to lie on the mat without any quilt. On the third day of it I was unable to move and just barely lived like a worm. Nearly everybody around us had the same disease."

During this stage a number of patients were examined by the Japanese investigators and their white blood cell counts were found to be low, even as low as $150/\text{mm}^3$ instead of the normal 8000.

Not all patients passed through this stage of nausea and enteritis, but it was very common. Toward the end of August many patients began to develop boils, throat infections, and even gangrene of the mouth due to the absence of white blood cells to combat infection. The bacteria were able to invade body tissues since the normal mechanism for controlling them was destroyed.

These infections progressed rapidly and usually the patients died within three or four days.

Of all the body cells the white blood cells are among the most easily destroyed by radiation and the bone marrow cells which form them are also very susceptible to radiation injury. However, the marrow cells have some power of regeneration, and, if the period of danger from infection can be tided over, there is a chance they may resume their function and return to normal. Some of the cases studied still showed abnormally low blood counts as late as 25 Nov. 1945.

Some recovering cases gradually returned to normal and the white blood cells stayed at normal level. Some over-regenerated and showed an abnormally high, but not dangerous, number, say up to $25,000/\text{mm}^3$ returning later to normal levels of around 8000.

The presence of infection or of severe burns alters the reaction somewhat, but the trend is still of the same general type, the exact character of the response hinging on the secondary factors. Thus one blood count alone is of little value, and for all our hospital cases we have serial counts.

The earliest drop in leukocytes was in the lymphocyte fraction, but these recovered within a few days. With very low leukocyte counts - under 1000 - there were almost no granular cells and the count was made up of mononuclear cells and lymphocytes. Statistical analyses of the differential counts will be made later. In some of the more severe cases plasma-like cells were seen in the peripheral blood. Such cases as a rule soon died.

In the few fatal cases that were autopsied in the early periods (up to 17 August) Dr. MIYAKE reported that the bone marrow was yellow and essentially non-functioning.

The next most susceptible of the bone marrow elements, after the leukocytes, are the blood platelets. While not the only element favoring blood coagulation, they are important for it, and a drop in blood platelet count presages hemorrhages into the skin and other tissues. Such hemorrhagic cases developed most commonly in early or mid-September, and frequently appeared in those patients who also had low white blood cell counts.

In some of the cases we studied, this hemorrhagic tendency persisted as late as early December, but it was most prevalent in early and mid-September.

The slowest time of blood coagulation encountered was four hours.

The hemorrhages involved small patches (petechiae) or large foci (purpura) without reference to degree of exposure to radiation. Sometimes the two types occurred in the same patient.

At autopsy it was not infrequent to find the peritoneal, pleural, or pericardial spaces spotted with petechiae. Sometimes extensive hemorrhages occurred from bladder, intestine, uterus or nose. Swelling, infection and bleeding of the gums was a very common feature.

SECRET

Col. DeCoursey and Comdr. Warren (MC) USNR performed 14 autopsies on patients dead from radiation reaction (atomic) and, together with Lt. Col. Leibow, with the cooperation of Dr. TSUZUKI and Japanese pathologists, have obtained samples of tissues from practically all of the far too few (200) autopsies done on these cases.

In some of these they found hemorrhages involving peribronchial and parenchymal pulmonary tissue, the older ones often showing a necrotic center that at times expanded to actual abscesses. Certain cases showed submucous or intramuscular hemorrhage into the wall of the colon, rectum and sigmoid, with thickening of the wall and, in case of survival for a time, organization and thickening.

A full discussion of these and other manifestations will have to be deferred until after thorough microscopic studies have been made.

After the hemorrhagic manifestations passed their peak, anemia became obvious. This anemia actually had its onset at the time of the bombing, but since the circulating red cell is resistant to radiation injury, it is only as new red cells are needed and the old cannot be replaced that it becomes apparent. From the first, the output of new red blood cells does not equal the loss of old, and so anemia develops more or less rapidly as the bone marrow has less or greater regenerative power. In leukopenic or hemorrhagic cases the associated symptoms mask the anemia unless specifically looked for; after these symptoms have cleared, the anemia is more apparent.

In some of the sternal bone marrow punctures performed, an active marrow chiefly made up of very young forms was found. These they considered as probably failures in maturation as well as in production of cells.

A detailed analysis of the sternal marrow studies will be presented later. Col. LeRoy devoted special attention to this phase of the work.

In some cases autopsied, all elements of blood formation were markedly deficient - a type of reaction noted before as a result of heavy X-ray radiation or benzol poisoning, among other causes. This condition of aplastic anemia or panmyelophthisis may sometimes be helped by blood transfusions.

No effective blood transfusion was done by the Japanese either at HIROSHIMA or NAGASAKI.

Changes in the Skin and Hair:

1. The most common change noted was hair loss, usually restricted to the scalp, and often partial rather than complete. Eyebrows and eyelashes were seldom affected. Radiation cases frequently could be picked out on the streets by watching for this hair loss. Some of the milder cases showed slight regeneration in November, and it is likely that further regeneration will occur.

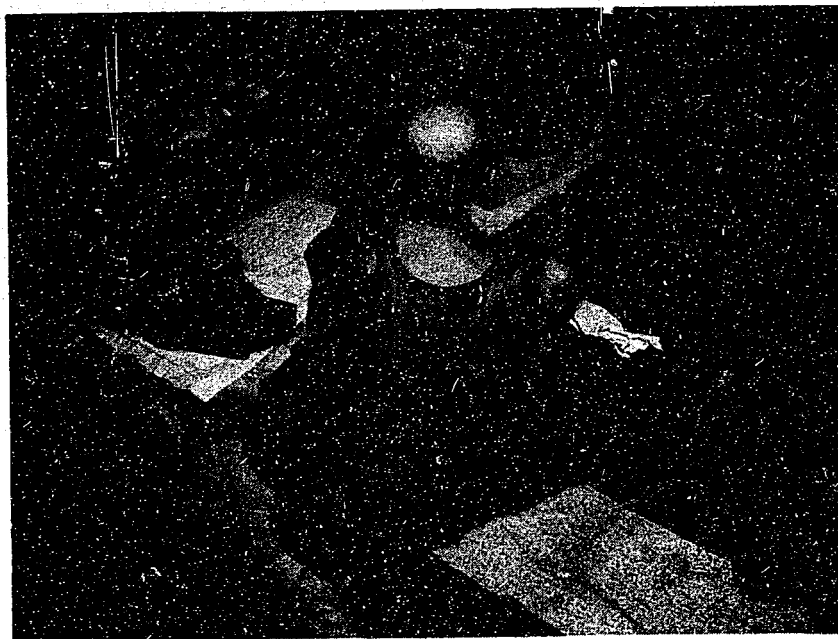


Figure 12
SEVERE EPILATION OF MAN'S SCALP
Partial protection at occiput due
to shielding by rest of head.



Figure 13
PARTIAL EPILATION OF WOMAN'S SCALP
(Note unchanged eyebrow.)

GRAPH 7

EFFECT UPON MENSTRUATION

NAGASKI

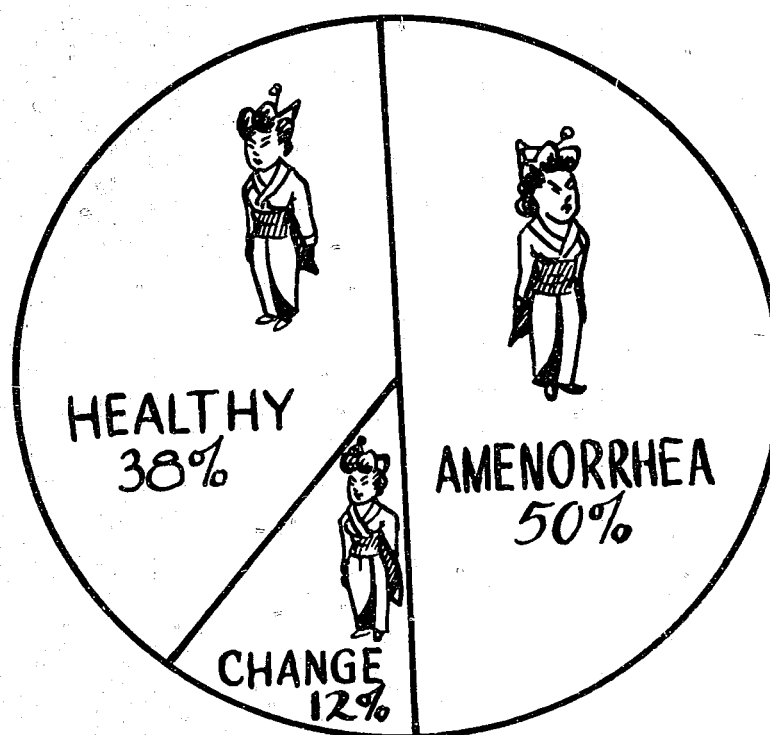




Figure 14

PARTIAL EPILATION OF CHILD'S SCALP

Flash burn, well healed, over left shoulder and arm.

2. Skin changes characteristic of response to radiation injury were not noticed. Some may have occurred, but were masked by burns. Delayed reactions may not appear until some time in the future. Microscopic study of specimens of skin may settle this point.

Effect on Endocrine Glands:

1. Adrenals. Cortical adrenal atrophy was often noted at autopsy, but no typical Addisonian syndrome was encountered.

2. No other significant changes other than in the gonads were noted.

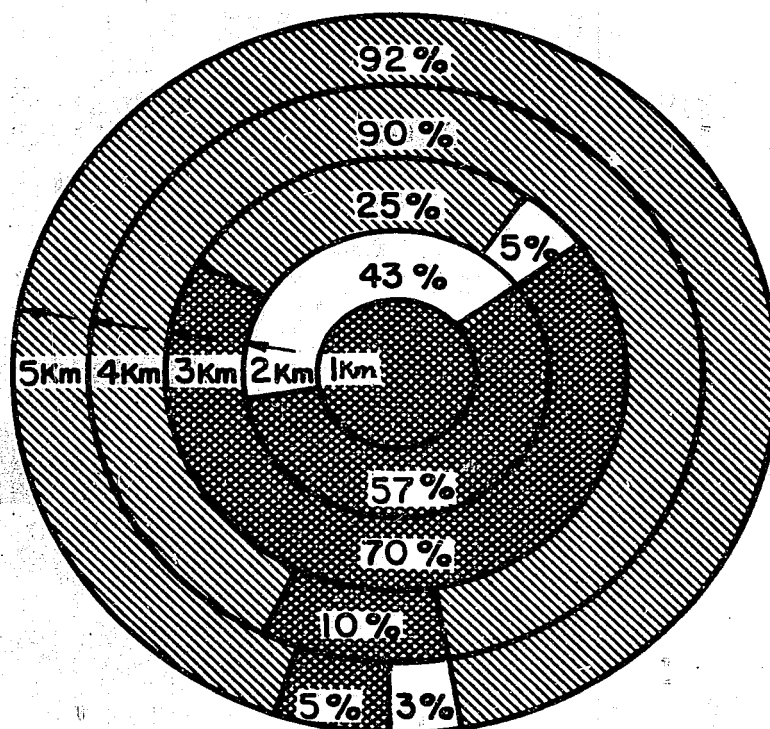
Effect on Gonads:

1. Testes. Sperm counts were done in about 40 cases by Japanese doctors, and some reported to be low, while an occasional one showed no sperm. We have had no experience in this field. Several autopsies on males revealed the testes to be atrophied and no sperm were found on impression smears.

Potency was apparently not affected, except as influenced by general debility.

2. Ovaries. Dr. KAIDA of Kyushu University, Lt. Comdr. Charles L. Stevenson, (MC), USNR and our group studied a group of 373 sexually mature NAGASAKI school girls, 43 nurses from the Nagasaki Medical School, and 61 women and girls from NAGASAKI hospitalized at OMURA. Graph 7 gives the result of this study. On those who were within three kilometers of the hypocenter, 38 percent showed no change in menstruation, 12 percent showed some definite change, as scanty flow or irregular flow, and 50 percent had not menstruated since the bomb. Only time will tell how much of this change may be due to psychic trauma and how much due to malnutrition or exposure.

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 Shinkozon 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.

These cases all showed varying degrees of flash burn and/or radiation injury. Twenty-three of 38 cases showed levels below 6.5 grams per 100 cc. The albumen-globulin ratio was surprisingly low in all cases. Eighteen cases were severely anemic.

Low blood protein level is not a direct effect of the bomb.

2. Non-protein Nitrogen. Owing to laboratory limitations, no determinations were made. Scattered observations from Japanese sources showed no abnormality.

3. Blood Sugar. No abnormalities were noted.

4. Vitamin Content. Some Japanese investigators believe the vitamin content to be low, especially vitamin C. No evidence exists that any vitamin deficiency is related to atomic bomb injury.

5. Electrolyte Changes. No facilities were available for such studies.

* * * * *

Part II RESIDUAL RADIOACTIVITY

The atomic bombs exploded at NAGASAKI on 9 August 1945 and at HIROSHIMA on 6 August 1945 gave rise to a residual radioactivity in these areas. The residual activity occurred from one or both of two causes (1) the deposition of radioactive products of explosion or unreacted explosive on the ground, or (2) the production of radio-isotopes in the ground materials by the extremely intense neutron and gamma ray production incident to the explosion. The purpose of this investigation was the determination of the intensity and distribution of the residual activity, and its relation to possibly harmful physiological effects.

Method:

Measurements of the residual activity were made by means of the Naval Research Laboratory Radioactivity Dosage Meter*, employing a self-quenching copper cathode Geiger-Muller counter tube. The counter was calibrated in terms of micro-roentgens per hour (μ r/hr.) against 24.35mg of radium enclosed in a platinum shell of 0.5mm wall thickness. (The sensitivity of the counter varied from day to day so that frequent recalibration was necessary. In general, however, the sensitivity remained constant during one sequence of measurements.) It was assumed that 1mg of radium through 0.5mm Pt produces 8.4r/hr at a distance of 1cm. Thus the pellet used in calibration of the counter was assumed to produce 204.6 r/hr at 1cm. The radiation intensity at various distances was calculated by the formula:

$$I = \frac{I_0 e^{-\mu x}}{x^2}$$

where I is the r/hr at distance x cm

$$I_0 = 204.6 \text{ r/hr}$$

$$= 2.4 \times 10^{-4} \text{ r/hr- (assuming a wave length of 0.26A)}$$

* The counter was constructed by Lt. (jg) M. Eicher, H(S), USNR under the supervision of Dr. H. Friedman and his staff at the Naval Research Laboratory, Anacostia.

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 ground, 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 great reservation.

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 considerable interest physiologically. At the NAGASAKI center area the residual intensity at the hypocenter on 18 October 1945 was 53_{μ} r/hr which is well below the minimum tolerance dose of 4000_{μ} 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 800_{μ} r/hr were obtained, and the highest value measured was 1080_{μ} 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 4000_{μ} 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 leukocytosis 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 61_{μ} r/hr in the center area. The situation here may be regarded as parallel 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 28_{μ} 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 I. 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 50 r/hr Area | |
|-------------------|-----------------------|-----|-----------------------|-----|----------------------|-----|---------------------------------|-------|------------------|---------------------------|-------|
| | N | H | N | H | N | H | N | H | N/H | N | H |
| 50 r/hr | 100 | 90 | 25 | 60 | 63 | 75 | .012 | .018 | .667 | 1.00 | 1.00 |
| 40 r/hr | 125 | 140 | 88 | 80 | 106 | 110 | .035 | .038 | .921 | 2.92 | 2.11 |
| 30 r/hr | 250 | 265 | 138 | 230 | 194 | 248 | .118 | .193 | .611 | 9.83 | 10.7 |
| 20 r/hr | 350 | 425 | 238 | 313 | 294 | 369 | .270 | .428 | .631 | 22.50 | 23.8 |
| 10 r/hr | 500 | 510 | 325 | 475 | 413 | 492 | .534 | .749 | .713 | 44.5 | 41.6 |
| 5 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 radiation 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.

Seeds of rice and squash exposed to the bomb at NAGASAKI were obtained and will be studied for abnormalities. The botanical department at Kyushu Imperial University will study the local flora for development of abnormalities.

Effect of Terrain on Effectiveness of Atomic Bombs:

HIROSHIMA and NAGASAKI afford excellent contrast in terrain. The broad, flat plain of HIROSHIMA, cupped by hills, is in sharp contrast to the narrow, steep-sided valley bombed at NAGASAKI. Graph 3 shows at a glance the population distribution in relation to a two kilometer radius from the hypocenters of the bombs in the two cities. It also explains why casualties were so much less at NAGASAKI since much of the effective area of the blast encompassed only fields and woods.

When the bomb is detonated at a height so great that its rays can reach all slopes of a hill, there is no protective effect noted. If, however, the angle of slope is such as to be out of reach of the direct rays, protection will be afforded to a considerable degree.

In relation to residual radioactivity terrain is also important. Hills near the center are, of course, nearer the explosion than are valleys, and hence show a greater residual activity. High land to leeward of the explosion may show regions of high residual activity also. At NAGASAKI, as shown on Enclosure (I), residual radioactive material may be wind-borne for some distance. These points are well demonstrated by the radioactive contour* map of NAGASAKI, Enclosure (K).

Effect on Subterranean Structures:

No evidence of a crater exists at either HIROSHIMA or NAGASAKI.

It is estimated by Prof. K. SASSO, vulcanologist at the Imperial University of Tokyo, that not more than 10 percent of the energy liberated by the bomb was absorbed by the earth. Survivors sometimes mentioned infrequent shaking of the earth. At more distant points observers noted some shaking, but less than that of a moderate earthquake.

The seismologic observatory of the Imperial University of Kyoto had recordings available at the time of each atomic bomb explosion, but no evidence of earth disturbance was noted.

Electric car tracks and railroad tracks were not displaced by the explosion.

Water mains were not broken. However, effective water pressure was lost with the destruction of house connections.

*Possibly a better term is isionogen, parallel to isobar or isotherm.

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.

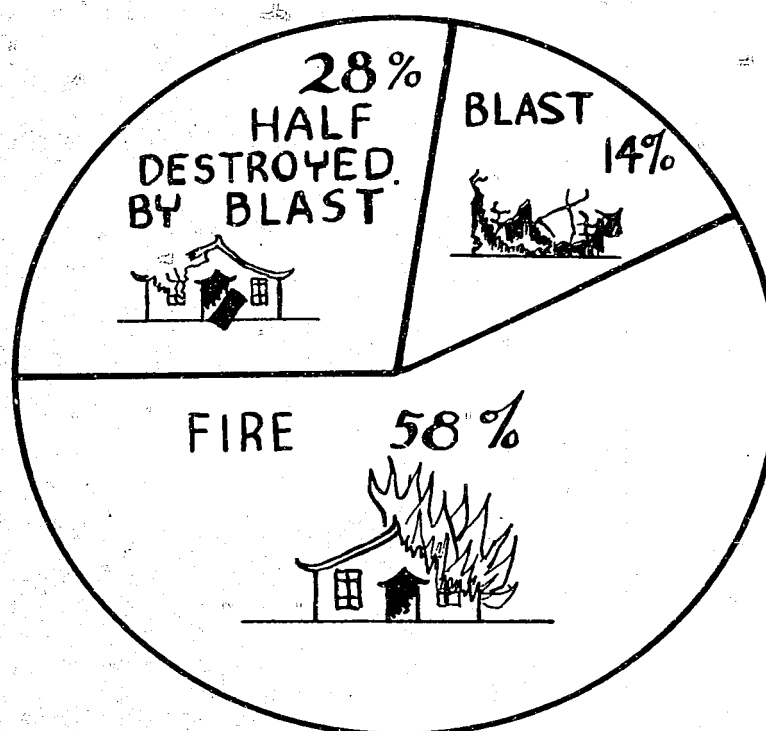
Many trapped in the ruins died by fire or shock unnecessarily.

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

GRAPH 9

EFFECT UPON WOODEN HOUSES

NAGASKI



oily dressings so far as material was available. This absence of adequate relief contributed to the heavy casualties. This was recognized in the army report of 14 August 1945, and corrective organization suggested.

2. NAGASAKI.

No effective relief organization existed. Patients were evacuated by train to the nearest hospitals outside the city, as ISAHAYA, OMURA and SASEBO, and some by ship to various ports, as UBE in southern HONSHU. Various rescue parties gradually entered the ruins, and an emergency hospital was set up at the Shinkozen School. This hospital, when entered in September, was filthy, open to the weather, with the patients lying on mats on the floor without care. Food and nursing care was provided by the patient's family. One had to pick one's way between puddles and piles of vomitus and feces. The Japanese habit of ubiquitous urination was freely indulged in. By October the hospital was greatly improved.

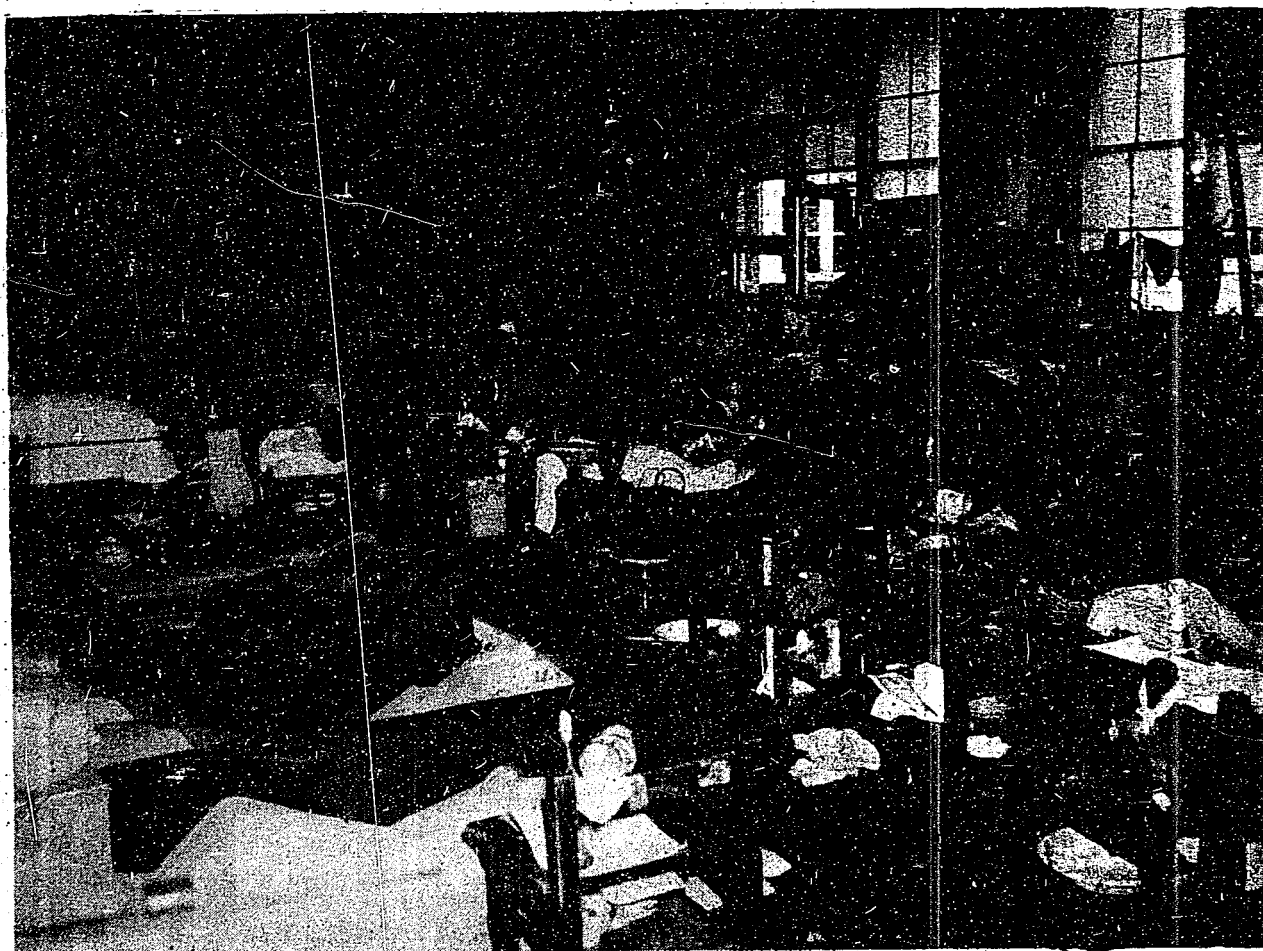


Figure 15

VIEW OF SHINKOZEN HOSPITAL ROOM IN OCTOBER

(Note patient urinating.)

The Japanese Naval hospitals gave reasonably effective care to those patients brought to them. As a general rule, the closer the hospital was to NAGASAKI, the sicker the patients were. Only the stronger could stand the trip to more distant points, where better care was available.

Care of uninjured survivors whose homes were destroyed was equally casual.

Since most of the construction in NAGASAKI was of wood, the extent of fire and blast damage greatly complicated the relief problem. Hardly a house in the city was undamaged. The relative destruction caused by fire (58 percent) and by blast (14 percent totally destroyed and 28 percent half destroyed) shows the importance of fire. Graph 9 illustrates these points.

* * * * *

Part IV ORGANIZATION OF RESEARCH IN NUCLEAR PHYSICS IN JAPAN

On the basis of interviews with Dr. H. NAGAOKA, Dr. Y. NISHINA, Dr. K. SUGIURA, and Dr. M. TSUZUKI of TOKYO; Dr. T. ASADA, Dr. KIKUCHI, and Dr. T. ITOH of OSAKA; Dr. SHINOHARA of KYUSHU; and Dr. ARAKATSU of KYOTO, the leading physicists in this field, the following estimate has been made of research in nuclear physics during the war.

Organized research was non-existent before and during the war. Individual scientists were given special assignments for work under secret conditions by the Army or Navy. Many scientists left the laboratories for combat service.

Before the war but little governmental support was given research in nuclear physics. Most support came from university funds or as research grants from the MITSUI interests.

While a system of war-time priorities existed, none was allotted to nuclear physics. Uranium could be obtained from KOREA, and a fair stockpile existed as it was used by the porcelain industry.

A total of seven to eight grams of radium exists in JAPAN, most of which is used medically.

The cyclotrons have now been destroyed.

No scientific data bearing on atomic fission was received from Germany, although detailed plans of V-1 and V-2 rockets were sent.

Such speculation about nuclear fission as existed in JAPAN was concerned with atomic energy for guns rather than bombs.

* * * * *

Part V CONCLUSIONS

1. The atomic bomb is the most terrible agent of destruction known to man.
2. Most injuries and deaths were caused by flash burn from the bomb burst itself or secondary flame burns.
3. Many injuries and deaths were caused by flying debris, falling buildings, violent displacement of persons by blast, or other types of direct trauma.

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 adequately. 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).

* * * * *

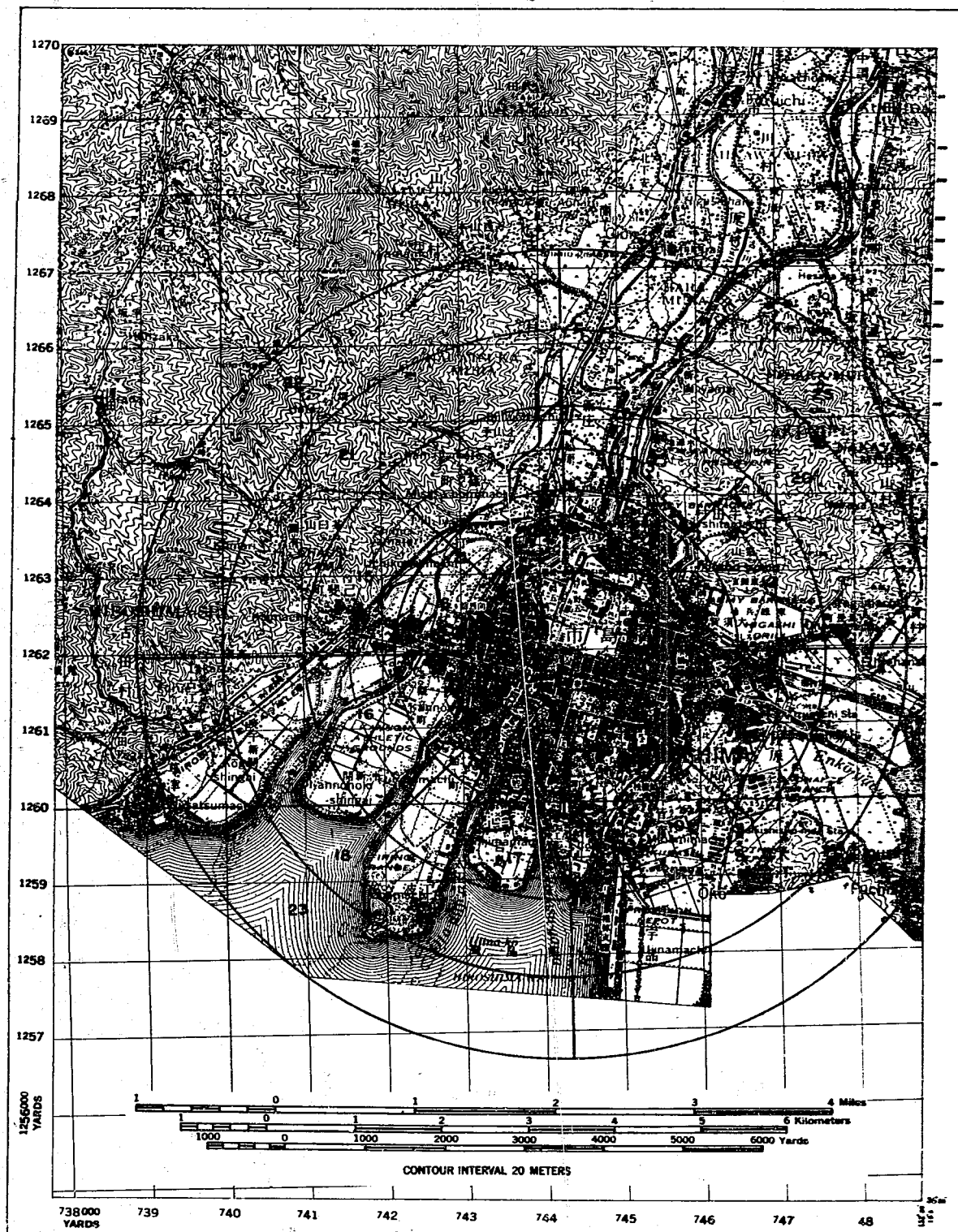
Part VI RECOMMENDATIONS

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 has 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.

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ENCLOSURE (A)



ENCLOSURE (B)

ARMY DAMAGES AT HIROSHIMA
(Sources: RAF Team, USSBS)

Personnel casualties in the various units of the CHUGOKU Army District are as shown in the following tables.

SUMMARY OF PERSONNEL CASUALTIES

| Classification | Uninjured | Killed | Wounded | Missing | Total |
|----------------|-----------|--------|---------|---------|-------|
| Officers | 151 | 81 | 330 | 307 | 869 |
| Sub. & NC Off. | 315 | 80 | 375 | 342 | 1,112 |
| Soldiers | 1,718 | 331 | 1,963 | 1,719 | 5,731 |
| Civil Service | 131 | 93 | 305 | 409 | 938 |
| Total | 2,315 | 585 | 3,973 | 2,777 | 8,650 |

INVESTIGATION OF PERSONNEL; 12 AUG. 1945
CHUGOKU ARMY DISTRICT HQ

| | Army Dist HQ | 1st Inf Repl Unit | Artillery Repl Unit | Engineer Repl Unit | Signal Repl Unit | Transport Repl Unit |
|---------------|-----------------|----------------------|------------------------|-----------------------|---------------------|------------------------|
| Officers | | | | | | |
| Dead | 28 | 17 | 8 | 3 | 2 | 12 |
| Injured | 45 | 48 | 12 | 13 | 18 | 23 |
| Missing | 12 | 93 | 77 | 1 | 23 | 7 |
| Uninjured | 35 | 29 | 15 | 22 | 5 | 10 |
| Total | 120 | 187 | 112 | 39 | 48 | 52 |
| NCOs | | | | | | |
| Dead | 25 | 22 | 9 | 4 | 5 | 7 |
| Injured | 81 | 130 | 15 | 32 | 20 | 27 |
| Missing | 18 | 127 | 71 | | 23 | 34 |
| Uninjured | 46 | 66 | 40 | 64 | 25 | 28 |
| Total | 170 | 345 | 135 | 100 | 73 | 96 |
| Soldiers | | | | | | |
| Dead | 15 | 91 | 13 | 14 | 7 | 169 |
| Injured | 96 | 618 | 189 | 317 | 185 | 226 |
| Missing | 67 | 654 | 390 | 3 | 153 | 93 |
| Uninjured | 94 | 297 | 407 | 500 | 47 | 119 |
| Total | 272 | 1,660 | 999 | 834 | 392 | 607 |
| Civil Service | | | | | | |
| Dead | 87 | | 2 | | | 6 |
| Injured | 118 | | 7 | 1 | | 1 |
| Missing | 93 | | 6 | | | |
| Uninjured | 96 | | | | | |
| Total | 394 | | 15 | 1 | | 7 |
| Grand Total | 956 | 2,192 | 1,261 | 974 | 513 | 762 |

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ENCLOSURE (B), continued

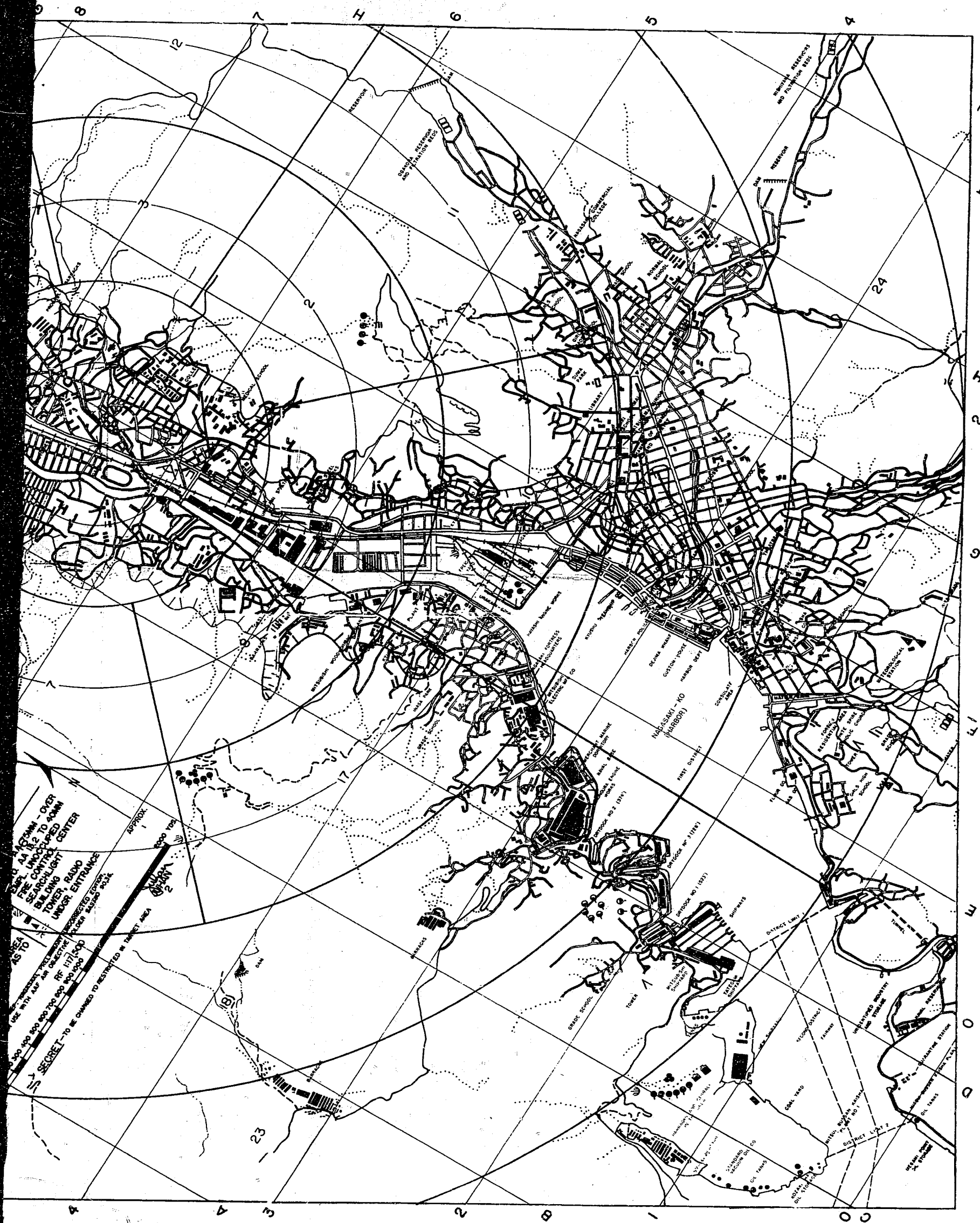
INVESTIGATION OF PERSONNEL; 12 AUG. 1945
(Continued)

| | Hosp Hiroshima 1st Army | Hosp Hiroshima 2nd Army | Hiroshima Dist HQ, RG Dist HQ | 105 Spec Garr Eng | Army Dist Trg Unit | Grand Total |
|----------------------|-------------------------------|-------------------------------|-------------------------------------|----------------------|-----------------------|----------------|
| Officers | | | | | | |
| Dead | 4 | 3 | 3 | 1 | | 81 |
| Injured | 16 | 3 | 6 | 6 | 140 | 330 |
| Missing | 5 | 9 | 10 | | 170 | 307 |
| Uninjured | 10 | 5 | 12 | 7 | 1 | 151 |
| Total | 35 | 20 | 31 | 14 | 211 | 869 |
| NCOs | | | | | | |
| Dead | 5 | | 2 | 1 | | 80 |
| Injured | 6 | 7 | 22 | 12 | 23 | 375 |
| Missing | 34 | 8 | 21 | | 6 | 342 |
| Uninjured | 15 | 3 | 8 | 17 | 3 | 315 |
| Total | 60 | 18 | 53 | 30 | 32 | 1,112 |
| Soldiers | | | | | | |
| Dead | | | 1 | 9 | 12 | 331 |
| Injured | 20 | 39 | 7 | 77 | 189 | 1,963 |
| Missing | 160 | 137 | 10 | | 50 | 1,719 |
| Uninjured | 80 | 9 | 4 | 147 | 14 | 1,718 |
| Total | 260 | 187 | 22 | 233 | 265 | 5,731 |
| Civil Service | | | | | | |
| Dead | 2 | | 2 | | | 93 |
| Injured | 110 | 53 | 10 | | | 305 |
| Missing | 149 | 145 | 15 | | | 409 |
| Uninjured | 25 | 9 | 1 | | | 131 |
| Total | 286 | 207 | 28 | | | 938 |
| Grand Total | 641 | 432 | 134 | 277 | 508 | 8,650 |

ENCLOSURE (B), continued

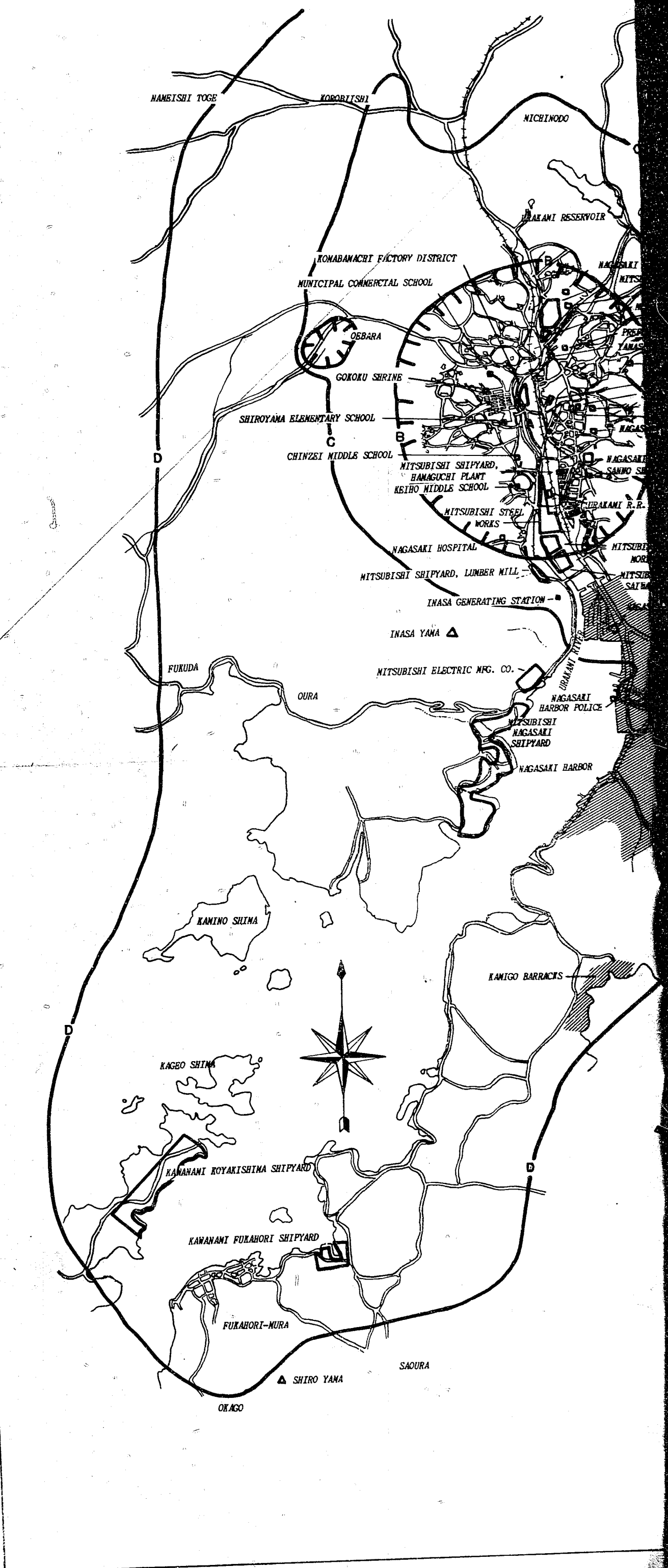
PERSONNEL AND LOCATION OF ARMY UNITS IN HIROSHIMA VICINITY

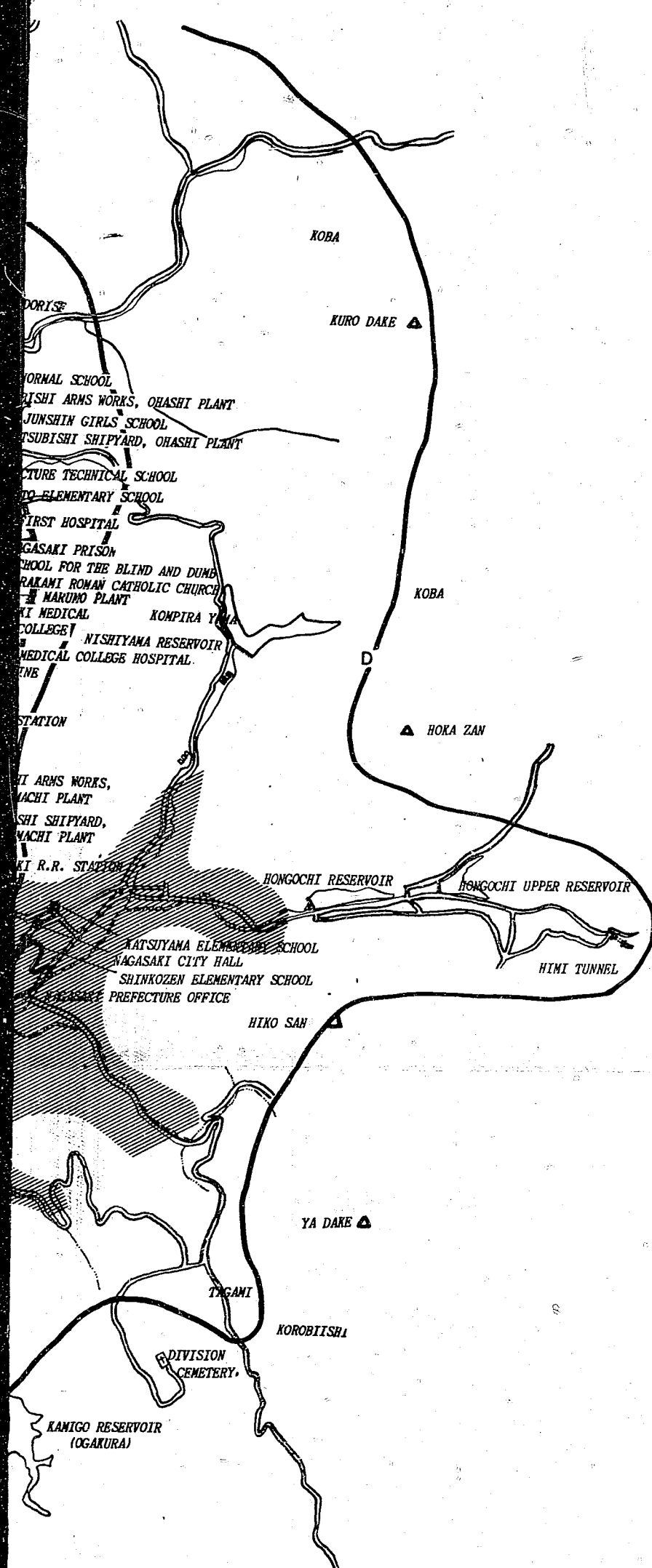
| <u>Name</u> | <u>Location</u> | <u>Personnel</u> |
|---|-------------------|------------------|
| Army Dist HQ | 1-Motomachi | 956 |
| 1 INF Repl Unit | Motomachi | 2,192 |
| Artillery Repl Unit | Motomachi | 1,261 |
| Engineer Repl Unit | Motomachi | 974 |
| Signal Repl Unit | Motomachi | 513 |
| Transport Repl Unit | Motomachi | 762 |
| Hiroshima 1st Army Hosp | Motomachi | 641 |
| Hiroshima 2nd Army Hosp | Motomachi | 432 |
| Hiroshima Reg HQ | Motomachi | 134 |
| 205 Spec Gar ENG Unit | Motomachi | 277 |
| Military Dist Train'g Unit | Motomachi | 508 |
| 124 Indep't Mixed Unit: | | |
| Artillery | Motomachi | 78 |
| Engineering | Motomachi | 74 |
| Signal | Motomachi | 46 |
| 224 Division: | | |
| Headquarters | Motomachi | 341 |
| Engineer | Motomachi | 113 |
| Signal | Motomachi | 12 |
| Transport | Motomachi | 16 |
| Shipping HQ | Niho, Hiroshima | 4,783 |
| Shipping HQ, Hirosh. Br. | Niho, Hiroshima | 67 |
| Artillery HQ Unit of | Kasumimachi, | |
| Shipping HQ | Hiroshima City | 677 |
| Artillery Train'g Unit of | | |
| Shipping HQ | Ujina | 555 |
| Signal Repl Unit of | | |
| Shipping HQ | Mihara | 5,600 |
| Army Shipping Train'g | Ujina | 2,945 |
| Field Shipping Main Depot | Sakamura | 969 |
| 208 Land Service Co | Yokogawa | 560 |
| 14 Med Sec Hospital Ship | Ninoshima | 100 |
| 53 Med Sec Hospital Ship | Ninoshima | 101 |
| Shipping Med Unit HQ | Ninoshima | 234 |
| 11/20 Sea Outfit Vol Unit | Kaitaichi | 3,090 |
| Hiroshima Army Arms Supply Depot | Kasumimachi, | |
| | Hiroshima City | 1,081 |
| | Kasumimachi | 82 |
| | Ujina | 165 |
| Hiroshima Army Clothing Branch Depot | | |
| Hiroshima Army Food Supply Branch Depot | | |
| Osaka Army Misc Supply Branch Depot, | | |
| Hiroshima Branch | Yano | 21 |
| Osaka Army Vet. Material Branch Depot, | | |
| Hiroshima Branch | Funakoshi Town | 6 |
| Hiroshima Station HQ | Hiroshima Station | 10 |
| Hiroshima District RR HQ | Ujina | 25 |
| Chugoku MP HQ | Motomachi | 219 |
| Kure District MP Unit | Kure | 149 |



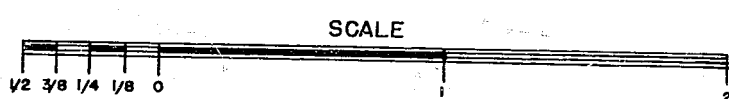
ENCLOSURE (C)

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NAGASAKI POLICE DAMAGE MAP



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.

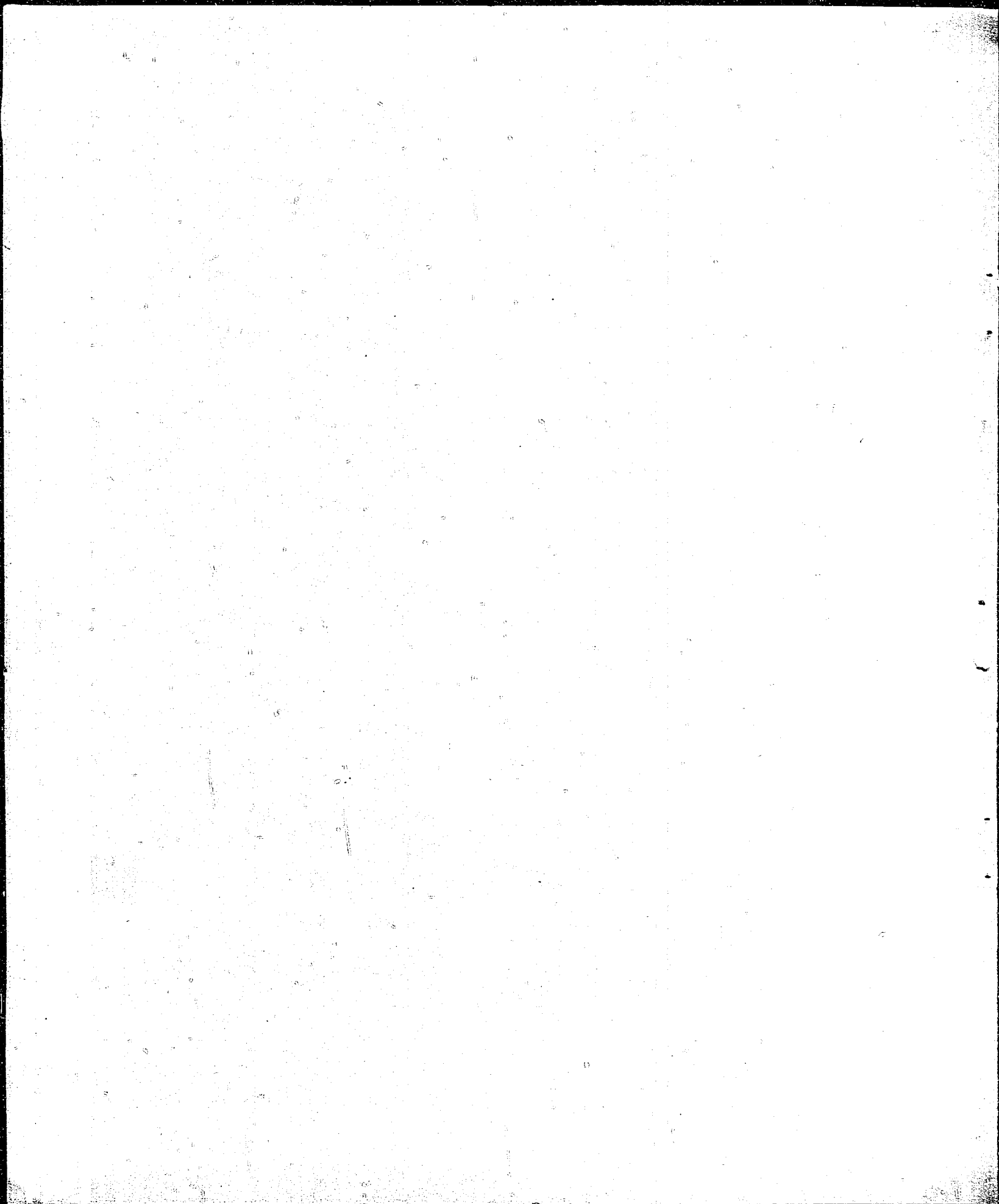
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ENCLOSURE (E)

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 |



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ENCLOSURE (F)

SUMMARY OF DAMAGE TO PERSONNEL & INSTALLATIONS AT NAGASAKI ACCORDING TO JAPANESE DOCUMENTS

Summary By:

H.F. Harnsberger, Lt.(jg) USNR
F.G. McKnight, Lt.(jg) USNR
O.R. Wheeler, Lt.(jg) USNR

NavTechJap Team #11-100

ENCLOSURE (F)

OUTLINEI. PERSONNEL

- A. Area Within a Radius of 500 Meters From the Explosion Center
- B. Area Within a Radius of 1000 Meters From the Explosion Center
- C. Area Within a Radius of 2000 Meters From the Explosion Center
- D. Area Outside a Radius of 2000 Meters From the Explosion Center
- E. Total Personnel Affected
 - 1. Casualties and Missing
 - 2. Victims
- F. Medical Observations

II. INSTALLATIONS

- A. Area Within a Radius of 500 Meters From the Explosion Center
- B. Area Within a Radius of 1000 Meters From the Explosion Center
- C. Area Within a Radius of 2000 Meters From the Explosion Center
- D. Area Outside a Radius of 2000 Meters From the Explosion Center
- E. Total Damage Picture
 - 1. Number of Buildings
 - 2. Area Affected

I. PERSONNEL

- A. Area Within a Radius of 500 Meters From the Explosion Center

No survivors were found either inside or outside buildings.

- B. Area Within a Radius of 1000 Meters From the Explosion Center

Almost all people and living creatures in general were killed instantly by the terrific concussion and intense heat. However, those people in caves escaped instant death. Many instances of rupture of the intestines, disembowelment, and eyeballs blown from the sockets were seen among the dead.

- C. Area Within a Radius of 2000 Meters From the Explosion Center

Some people were killed instantly by the intense blast and heat. The greatest part of the remainder were injured either seriously or slightly. There were also many cases of burns within this area.

- D. Area Outside a Radius of 2000 Meters From the Explosion Center

People outdoors suffered flash burns on exposed portions, while those inside were not affected. This was the case with personnel on board ships in the harbor for instance. In addition, people were injured, either seriously or lightly, by shattered window panes and other debris scattered by the blast. Beyond 5000 meters, a few flash burns were reported, and some slight injuries caused by material blown about by the blast. But in general no injuries were sustained in the area 5000 meters or more from the explosion center.

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ENCLOSURE (F), continued

E. Total Personnel Affected1. Casualties and Missing (as of 1 September)

- a. Dead (inquest completed) 19,743
- b. Missing 1,927
- c. Seriously or slightly injured 40,993

These figures can be further broken down into police station districts as follows:

| | Dead | Missing | Total |
|--------------------------------|--------|---------|--------|
| NAGASAKI Police Station | 16,390 | 791 | 17,181 |
| UMEGASAKI Police Station | 126 | 129 | 255 |
| INASA Police Station | 5,034 | 1,007 | 6,041 |
| NAGASAKI Harbor Police Station | 34 | | 34 |
| Outside NAGASAKI City | 1,775 | | 1,775 |
| TOTAL | 23,359 | 1,927 | 25,286 |

The discrepancy in the total number dead is due to the fact that in addition to the 19,743 known dead (autopsies completed) the second table has an extended total estimated on the basis of survivors' reports. The number of missing comes from reports brought in by relatives of those missing. On the basis of the breakdown by police station districts, it is estimated that half the total population in the central explosion zone was killed. Although the report giving the casualty figures by police station districts has the extended total of 23,359 killed, another report estimated that the number of killed was not less than 25,000-26,000.

As of 1 September, the total number of patients treated in aid stations was 40,993 out of which number 20,203 had died, and 1,653 had been discharged.

An interesting sidelight is that out of a total of 15,751 employees of principal factories and installations, out of which number 13,704 were at work on 9 August, 1,473 were killed, 1,165 were killed, 1,165 were seriously injured, and from 6,900 to 8,400 were slightly injured.

2. Victims

As of 26 August, a total of 21,174 households with a total number of 89,780 people were affected in some physical way by the atomic bomb. The 89,780 people were disposed of as follows:

- Evacuated outside NAGASAKI Prefecture 11,894
- Evacuated outside NAGASAKI City (inside prefecture) 20,399
- Living with friends or relatives in city 28,980
- Living in partly destroyed but repaired houses in city 23,498
- Living in temporary sheds or caves within city 5,009

F. Medical Observations

Those cases wounded immediately were largely burn cases, or cases with external injuries. Others who became ill after a period of 7-10

ENCLOSURE (F), continued

days were presumed to have been affected by after effects of the atomic bomb. The causes of the type of illness are thought to be:

1. The direct operation of gamma rays, and powerful neutron radiation.
2. The secondary radiation from buildings, etc., which had been affected by neutron radiation.
3. The operation of bodies of corpuscular radio-active materials.

Even lightly wounded cases were seriously affected and died rapidly, and it was estimated that the death rate among seriously wounded cases would reach a rate of two out of three. With such a high fatality rate, it worked out that persons within a 200 meter radius from the explosion center for the most part died even though they had escaped death at the time of the explosion.

II. INSTALLATIONS

A. Area Within a Radius of 500 Meters From the Explosion Center

1. Marked vertical blast was noted very near the center. Electric poles were left intact, but the cross bars were blasted downward.
2. All wooden buildings were smashed. Reinforced concrete buildings were battered and burned out, but remained standing in part. Steel-frame buildings were badly mangled and crushed. Heavy machinery was smashed.
3. Concrete roads, embankments, and bridges were torn up, blown in, or displaced.
4. Trees up to 3 ft. in diameter were uprooted. The path of the blast was very apparent from the radial direction toward which trees and electric poles were toppled.
5. Earth-covered and cave-type air-raid shelters were left largely intact.
6. All vegetation was burned over by the flash, but no damage was inflicted on portions underground.
7. Boats in the rivers and canals (up to 100 tons) were either destroyed or sunk.

B. Area Within a Radius of 1000 Meters From the Explosion Center

1. The path of the horizontal blast was apparent from the radial inclination of various structures from the explosion center.
2. All wooden buildings in the area were smashed. Reinforced concrete buildings were damaged in varying degrees. Steel-frame buildings were mangled severely. Sheet-iron roofs and walls were blasted in completely.
3. Concrete roads and bridges exhibited only moderate damage.
4. Trees and electric poles were toppled radially from the explosion center, except in a few instances where the blast seemed to have been deflected by immovable structures.
5. Cave-type air-raid shelters sustained no damage.

ENCLOSURE (F), continued

6. Vegetation was largely burned over.

C. Area Within a Radius of 2000 Meters From the Explosion Center

1. All wooden buildings collapsed. Reinforced concrete buildings escaped damage, except for bent window-frames, broken panes, etc. Steel-frame buildings were heavily damaged, whole structures being inclined by the blast.

2. Concrete roads and bridges exhibited only slight damage.

3. Cave-type air-raid shelters were undamaged.

4. Vegetation was partially burned over by the flash.

D. Area Outside a Radius of 2000 Meters From the Explosion Center

1. Damage to ships in NAGASAKI Inner Harbor was moderate. Panes were broken; plates and beams were sprung. Several lighters were sunk. Wooden decks were damaged, some catching fire from the flash. Sections were thrown out of line.

2. Damage to buildings and structures of all types decreased rapidly progressing out from the explosion center beyond the 2,000 meter curve. Only moderate damage was noted in well-constructed buildings outside the 3,000 meter curve.

3. Forests up to 5,000 meters from the explosion center and which were open to the flash were burned out.

4. The blast was felt over an area up to 25 miles from the explosion center, but damage to installations in the large peripheral area was generally minor.

E. Total Damage Picture

1. Number of Buildings

| | |
|----------------------------|---------------------------|
| a. Totally destroyed | 14,146 |
| b. Burned out | 11,494 |
| c. Half-destroyed | 5,441 |
| d. Partly damaged | all buildings in NAGASAKI |

2. Area Affected

| | |
|---|-------------|
| a. Totally destroyed and burned (central explosion zone) | 4.7 sq. km. |
| b. Burned out | 20 sq. km. |
| c. Half-destroyed or partly damaged | 104 sq. km. |

ENCLOSURE (F), continued

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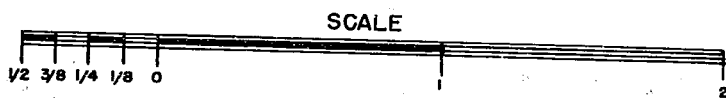
1. Secret Report #1-112, KYUSHU Naval Stores Inspectorate, NAGASAKI Branch, 28 September 1945.
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5. Blueprint of NAGASAKI City, dated September 1944, with police damage area data added in September 1945.

SECRET





NAGASAKI POLICE DAMAGE MAP



○ Schools Covered in Survey
of Effects on 373 Girls

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." | | | | |

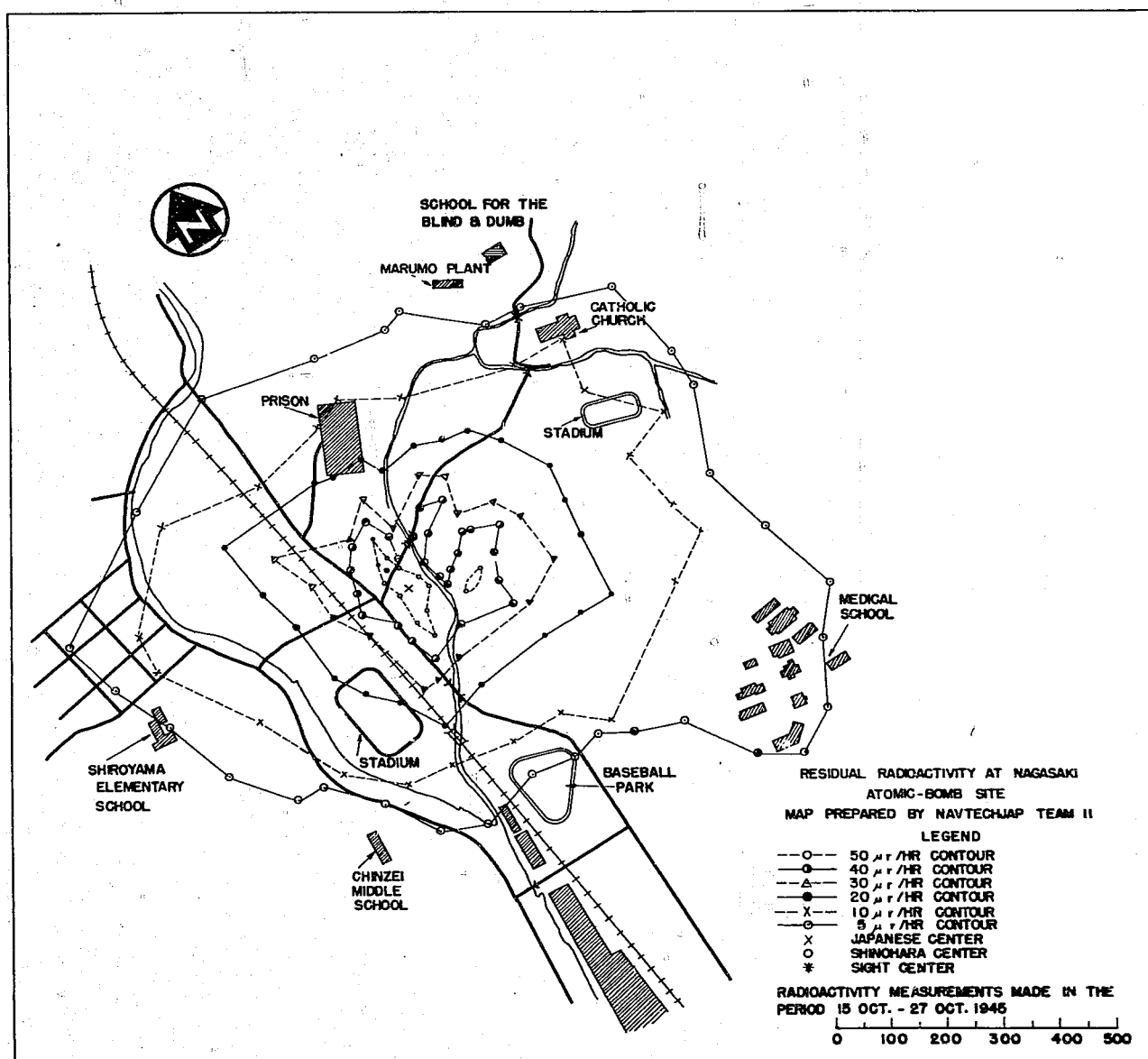
ENCLOSURE (I)

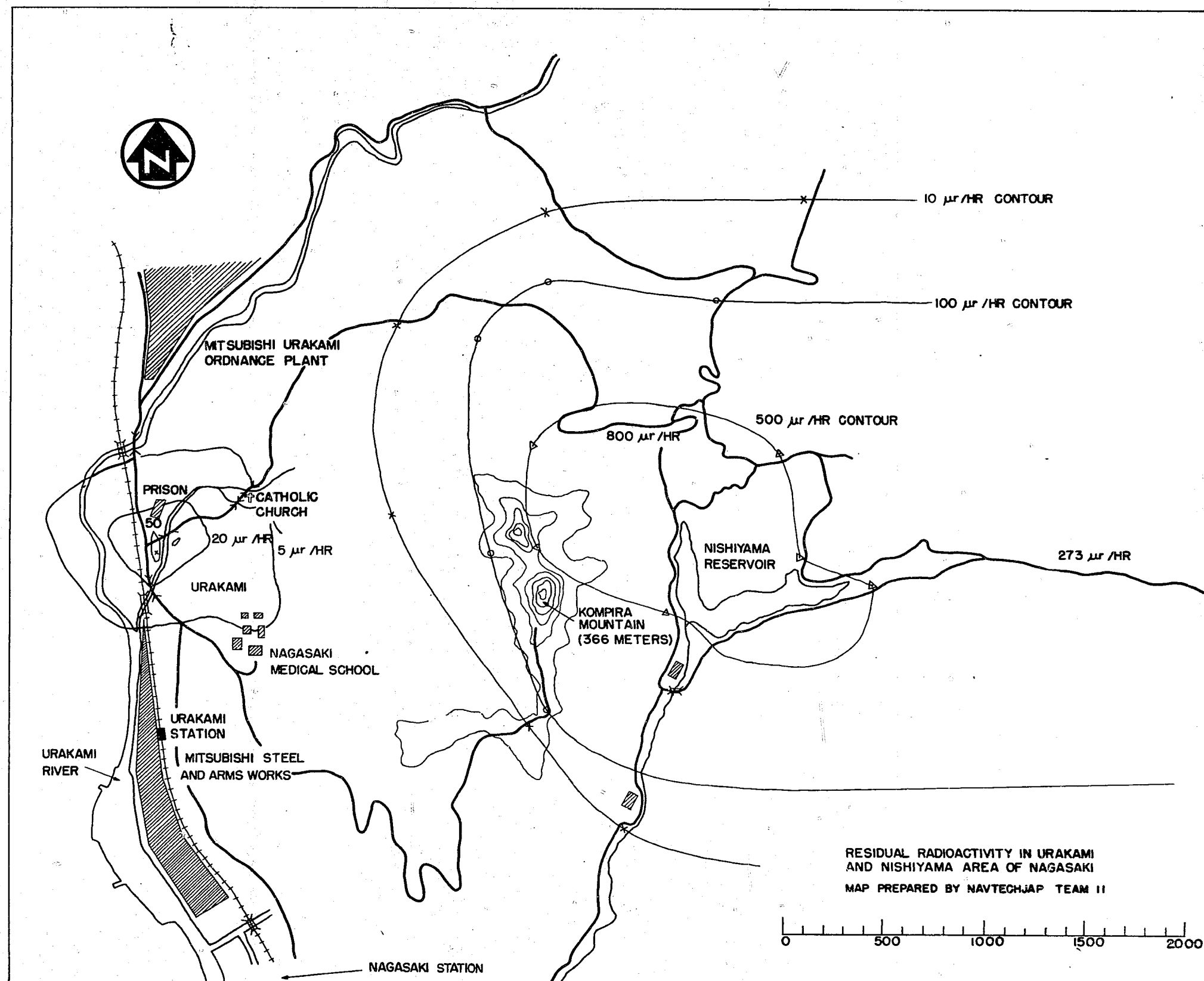
ENCLOSURE (I)
BLOOD PROTEIN STUDIES KYUSHU IMPERIAL UNIVERSITY

| No. | sex | age | days after bomb | w.b.c. | r.b.c. (million) | sed. vel. r.b.c. (mm/h) | sed. vel. r.b.c. (mm/2h) | tot. prot. (g/100cc.) | non pro. n(mg/100cc.) | albumin (g/100cc.) | globulin (g/100cc.) | albumin globulin | auglob. (g/100cc.) | fibrinogen |
|-----------|-----|-----|-----------------|--------|------------------|-------------------------|--------------------------|-----------------------|-----------------------|--------------------|---------------------|------------------|--------------------|------------|
| 1 | m | 19 | 14 | 4000 | 3.50 | 65 | 125 | 7.4 | 29 | 0.9 | 6.5 | 0.13 | 6.5 | |
| 2 | f | 45 | 45 | 9700 | 6.40 | 32 | 62 | 6.1 | 39 | 1.3 | 4.6 | 0.32 | 2.4 | |
| 3 | f | 46 | 27 | 3600 | 1.70 | 95 | 138 | 3.8 | 28 | 0.9 | 5.0 | 0.06 | 4.6 | |
| 4 | f | 20 | 58 | 8400 | 3.20 | 98 | 121 | 6.8 | 38 | 0.9 | 5.6 | 0.15 | 2.9 | |
| 5 | f | 20 | 31 | 6800 | 2.50 | 98 | 144 | 5.6 | 49 | 0.7 | 4.9 | 0.14 | 4.6 | |
| 6 | m | 20 | 51 | 12800 | 4.30 | 6 | 17 | 6.0 | 21 | 1.5 | 4.5 | 0.35 | 2.1 | 320 |
| 7 | m | 52 | 19 | 1200 | 2.00 | 104 | 154 | 6.2 | 48 | 0.7 | 5.4 | 0.13 | | |
| 8 | m | 24 | 50 | 8000 | 4.00 | 36 | 51 | 6.8 | 32 | 1.3 | 3.7 | 0.35 | 0.5 | 314 |
| 9 | m | 22 | 32 | 3400 | 1.90 | 143 | 146 | 6.7 | 49 | 2.4 | 4.2 | 0.57 | 2.0 | 568 |
| 10 | m | 22 | 63 | 11800 | 4.00 | 40 | 92 | 6.8 | 35 | 0.7 | 5.7 | 0.12 | 2.9 | 578 |
| 11 | m | 22 | 28 | 7600 | 3.60 | 97 | 143 | 7.0 | 49 | 0.8 | 5.9 | 0.15 | 0.7 | 270 |
| 12 | m | 22 | 59 | 6300 | 4.00 | 20 | 46 | 6.3 | 22 | 1.8 | 4.3 | 0.42 | 2.3 | 491 |
| 13 | m | 22 | 26 | 5200 | 4.40 | 10 | 28 | 4.8 | 25 | 0.5 | 3.6 | 0.14 | 0.2 | 254 |
| 14 | m | 22 | 57 | 4300 | 2.10 | 2 | 7 | 5.2 | 32 | 1.3 | 3.7 | 0.35 | 0.5 | 314 |
| 15 | m | 22 | 20 | 800 | 2.70 | 100 | 136 | 6.4 | 25 | 0.7 | 5.6 | 0.12 | 5.1 | |
| 16 | m | 22 | 46 | 4600 | 3.40 | 21 | 53 | 6.4 | 28 | 2.2 | 4.0 | 0.35 | 2.0 | 639 |
| 17 | m | 22 | 54 | 4200 | 4.60 | 32 | 80 | 6.4 | 36 | 1.0 | 5.1 | 0.19 | 1.6 | 633 |
| 18 | m | 22 | 43 | 56 | 3.10 | 131 | 149 | 6.9 | 44 | 0.2 | 6.4 | 0.03 | 3.5 | 398 |
| 19 | m | 22 | 59 | 6600 | 2.40 | 60 | 120 | 6.6 | 38 | 0.7 | 5.5 | 0.13 | 0.6 | 227 |
| 20 | m | 22 | 19 | 6800 | 2.70 | 54 | 124 | 5.7 | 62 | 1.6 | 4.2 | 0.36 | 1.2 | 219 |
| 21 | m | 22 | 30 | 3500 | 2.50 | 40 | 84 | 6.3 | 44 | 0.8 | 5.0 | 0.16 | 0.1 | 65 |
| 22 | m | 22 | 26 | 2400 | 2.40 | 35 | 112 | 6.7 | 53 | 1.0 | 5.3 | 0.19 | 3.0 | 407 |
| 23 | m | 22 | 12 | 3200 | 3.60 | 134 | 143 | 6.9 | 31 | 1.4 | 5.3 | 0.27 | 3.9 | 538 |
| 24 | m | 22 | 50 | 5000 | 5.70 | 20 | 48 | 6.9 | 23 | 1.3 | 5.5 | 0.23 | 1.2 | 149 |
| 25 | m | 22 | 78 | 7400 | 4.30 | 43 | 84 | 6.3 | 26 | 0.3 | 5.7 | 0.05 | 0.9 | |
| 26 | m | 22 | 17 | 6100 | 3.10 | 45 | 96 | 6.9 | 36 | 1.7 | 4.9 | 0.38 | 0.4 | |
| 27 | m | 22 | 44 | 7600 | 4.75 | 18 | 48 | 7.3 | 27 | 1.5 | 5.6 | 0.23 | 0.6 | 496 |
| 28 | m | 22 | 61 | 7800 | 3.30 | 88 | 135 | 7.3 | 30 | 1.1 | 5.4 | 0.19 | 1.9 | |
| 29 | m | 22 | 66 | 6100 | 4.10 | 13 | 34 | 7.0 | 56 | 1.1 | 5.4 | 0.20 | 0.5 | 325 |
| 30 | m | 22 | 78 | 6500 | 3.20 | 36 | 76 | 7.6 | 33 | 1.5 | 5.8 | 0.25 | 1.5 | 508 |
| 31 | m | 22 | 17 | 3300 | 2.10 | 25 | 52 | 5.8 | 31 | 1.4 | 5.2 | 0.27 | 0.9 | 393 |
| 32 | m | 22 | 45 | 5400 | 4.30 | 40 | 78 | 5.8 | 22 | 0.5 | 4.9 | 0.10 | 0.3 | 996 |
| 33 | m | 22 | 16 | 7400 | 3.30 | 35 | 83 | 6.7 | 35 | 0.7 | 5.7 | 0.12 | 1.5 | 1022 |
| 34 | m | 22 | 33 | 6200 | 1.91 | 120 | | 7.5 | 47 | 0.5 | 6.8 | 0.09 | 4.5 | 670 |
| 35 | m | 22 | 19 | 6550 | 3.00 | 40 | 65 | 6.4 | 43 | 0.6 | 5.1 | 0.12 | 4.5 | 302 |
| 36 | m | 22 | 70 | 8200 | 2.40 | 125 | 247 | 6.3 | 33 | 0.8 | 5.2 | 0.15 | 4.9 | 48 |
| 37 | m | 22 | 17 | 70 | 3.90 | 25 | 50 | 7.0 | 52 | 0.6 | 6.0 | 0.10 | 5.2 | |
| 38 | m | 22 | 71 | 8600 | | 8 | 15 | 5.8 | 35 | 1.0 | 4.5 | 0.22 | 3.9 | 142 |
| 39 | m | 22 | 71 | 5250 | | | | 6.9 | 49 | 0.2 | 6.4 | 0.03 | 5.2 | 417 |
| 40 | m | 22 | 71 | 3900 | | 27 | 45 | 5.1 | 27 | 0.5 | 4.4 | 0.11 | 3.1 | 114 |
| 41 | m | 22 | 71 | 4000 | | | | 6.8 | 49 | 0.6 | 5.9 | 0.10 | 3.5 | 139 |
| 42 | m | 22 | 71 | 3900 | | 50 | 100 | 5.1 | 42 | 0.3 | 4.9 | 0.07 | 1.9 | 432 |
| 43 | m | 22 | 71 | 4200 | | 37 | 76 | 6.4 | 46 | 0.5 | 5.6 | 0.09 | 1.5 | 663 |
| 44 | m | 22 | 71 | 6450 | | 50 | 100 | 5.4 | 36 | 0.1 | 5.1 | 0.01 | 4.0 | 223 |
| 45 | m | 22 | 71 | 7100 | | 18 | 50 | 6.2 | 14 | 0.4 | 5.7 | 0.07 | 4.0 | 259 |
| 46 | m | 22 | 71 | 2450 | | | | | | | | | | |
| Standard* | | | | | | 4 | 12 | 7.0 | 32 | 4.2 | 1.8 | 0.8 | 0.5 | 296 |
| m since | | | | | | 8 | 18 | 6.9 | 37 | 4.3 | 2.4 | 1.7 | 0.5 | 302 |
| f Aug. 9 | | | | | | | | | | | | | | |

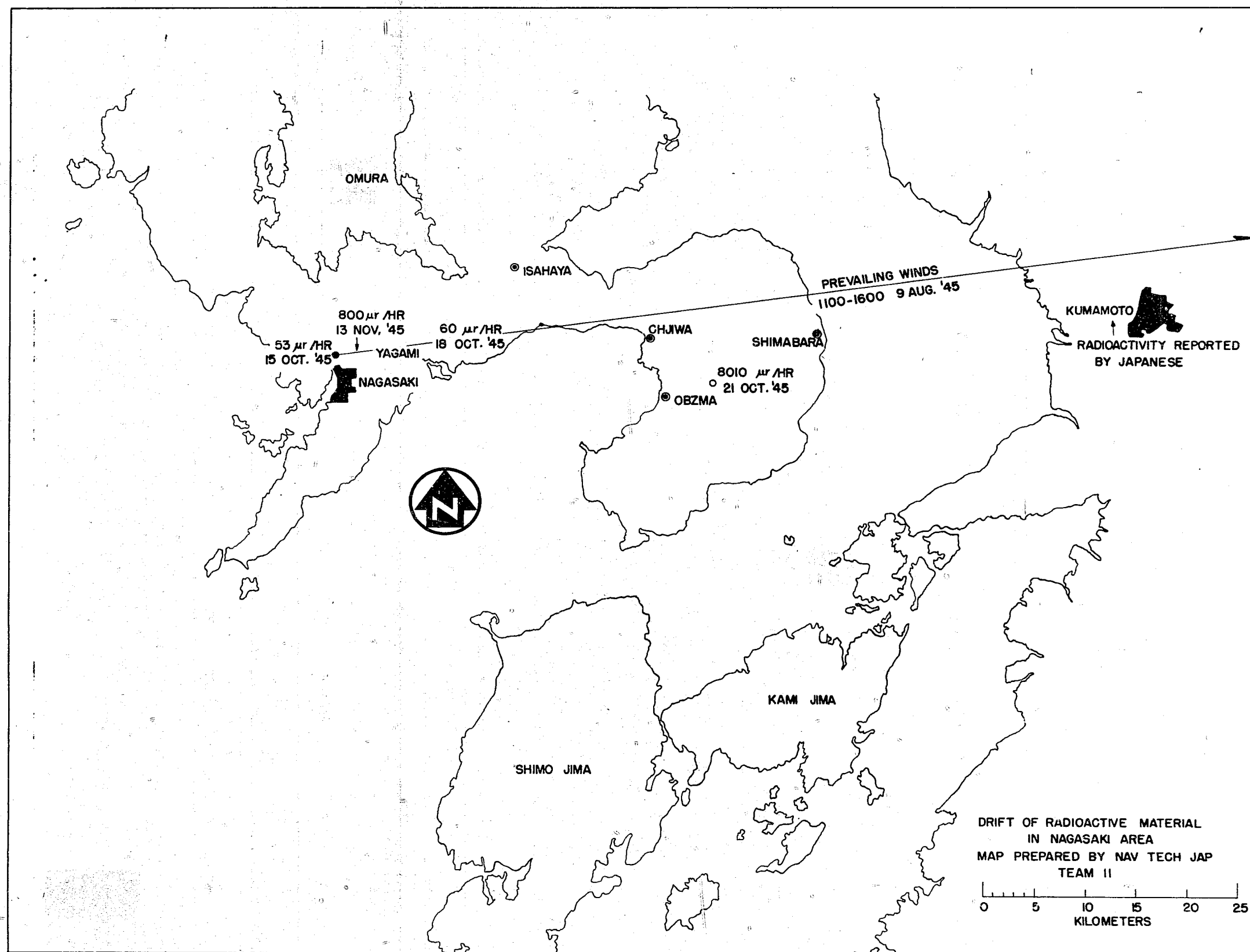
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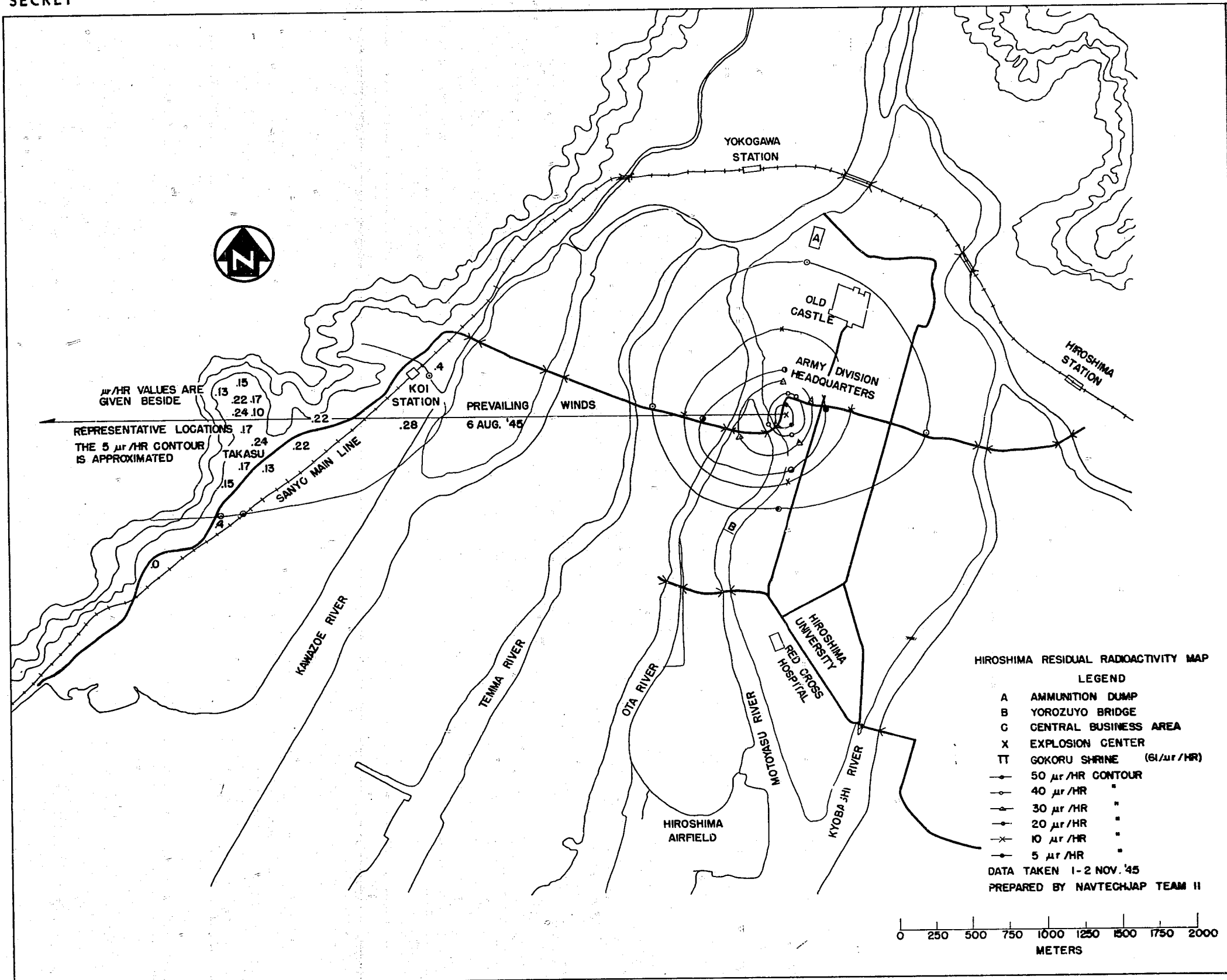




ENCLOSURE (K)



ENCLOSURE (L)



ENCLOSURE (M)