

CHAPTER III

Damages and Casualties by the Atomic Bomb

1. Damages to the City.

Some abstracts about the damages of the buildings will be at first pointed out, which are the basis for the surveys of the human casualties.

The survey at the Hiroshima district told us as follows: All wooden houses within a radius of 1 km from the ground center, were pulverized in an instant; wooden houses in the area between radii of 1 - 2 km were devastated totally; those in 2 - 3 km were destroyed severely; those in 3 - 4 km were damaged moderately. A severe destruction of the houses means a damaged condition in which nobody can live further. The floor mats were even blown up. Moderate damage means the houses are scarcely available to live in, for all doors and windows are blown off. The roof tiles slip down and the roof leaks heavily. The damage to doors and windows is seen up to 6 km. Slipping down of roof tiles up to 8 km. Breaking of the window glasses extends to around 16 km.

All concrete buildings are more resistant, even in the central area, for only upper roofs are damaged. All furnishings were stirred up completely. Outside a radius of 1 km from the ground center, there are almost no damage in a concrete building. All window glass was blown out to a distance of 2 km, and window frames toward the explosion center were also destroyed.

The fires caught all wood and concrete buildings in the area within a radius of 1 km from the ground center. The wooden houses were burned for the most part, in the area between radii of 1 - 2 km, partly burned in the area of 2 - 3 km. Some of the well constructed concrete buildings partially escaped from the fires, even in the area within a radius of 1 km from the ground center.

The official survey of the Hiroshima Prefecture revealed the total number of houses in the city of Hiroshima before the bombing to be 75,000; out of them 55,000 were totally burned (including totally destroyed and burned, and partially destroyed and totally burned), 12,600 partially burned, 6,820 totally destroyed, 3,750 partially destroyed. All damaged houses were counted and found to total 68,170, that is over 90% of all houses.

In the Nagasaki district, the destructive power seemed to be far greater. There are mountain chains running in a south-north direction, at both east and west sides of the bomb center. On the bombed side of the mountains the damage was more severe, behind them, it was slighter.

At Nagasaki, in the central area, all iron framed, slate or zinc covered factory plants were destroyed; roofs and walls were broken off, iron frames were also deformed and some of them twisted like jelly. This may be due to an influence of the fires too.

The Nagasaki Prefecture reported: 11,494 houses were totally burned, 21,652 houses totally destroyed (escaped from the fires), 5,441 houses

partially destroyed.

2. Statistics of the Sufferers.

Both at Hiroshima and Nagasaki, the actual population at the time of the bombing was not known for sure, because of evacuation of citizens, forced enlistment of workers into military factories, voluntary service of pupils and students, movement of military forces, etc. The exact data of casualties is not, therefore, well known. The following confusion at the war end made the estimation very difficult, despite all efforts from various sides.

The Hiroshima Prefecture reported, on August 25, 1945, (at the end of the 3rd week): 46,185 deaths, 17,429 missing, 19,691 severely injured, 44,979 slightly injured, 235,656 suffered, and in total 363,940 casualties. The report dated February 2, 1946, (after 6 months): 78,150 deaths, 13,983 missing, 9,428 severely injured, 27,997 slightly injured, 176,987 suffered, and in total 306,545. Out of the above calculations, 78,150 deaths and 13,983 missing are summed up in total to 92,133. As this number does not include the number of dead of the military forces - the total number of the death cases at Hiroshima will be estimated around 100,000.

The Nagasaki Prefecture reported the casualties on August 31, 1945. The number of the dead cases (examined officially) was 19,748, missing 1,924, wounded 40,993, and in total 62,665. The report on October 23, 1945: deaths 23,753, missing 1,924, wounded 23,345, suffered 89,025, and in total 138,805.

Dr. N. MASUYAMA, member of the Faculty of Medicine, Tokyo Imp. Univ. and Institute for the Statistical and Mathematical Studies, Educational Ministry, made a careful statistical survey on each of 6,000 families at Hiroshima in December 1945, and at Nagasaki in January, 1946, in collaboration with Lt. M. E. HABEL, member of the American Commission for the Investigation of the Effects of the Atomic Bomb. Excepting the military casualties, he estimated the number of dead at Hiroshima would be between a maximum of 63,670 and a minimum of 58,580, the number of wounded between a maximum of 72,880 and minimum of 68,810. At Nagasaki, he counted the number of dead, being between a maximum of 37,507 and a minimum of 29,398, and the number of wounded between a maximum of 26,709 and a minimum of 23,469. The calculated values seem to be lower, compared with those of other sources. The reason is based upon the elimination of uncertain cases and upon the count of exact cases which were directly affected by the atomic bomb.

Dr. MASUYAMA made also another survey on the death date rate, in viewing the official death records at the KABE Police Station, Hiroshima Prefecture. Daily increase of the total death number was indicated in a curve of an exponential function. Death rate diminished in a half value in about every 6 days. In other words, about 50% of all dying victims died by the 6th day, 25% died from the 7th to 12th day. By the 40th day after the bombing, over 99% of the dead cases have lost their lives. KABE is a small town, located about 15 km north from Hiroshima and along the KABE local railroad line. After August 6th many injured were transported to KABE. 331 deaths were recorded in 40 days until

September 14. The death rate survey at this town shall be understood, therefore, to be based upon the observations of those cases only, which could escape themselves from the disaster at Hiroshima, and the observations did not extend to the cases of immediate death or to the most severely wounded, who had lost their lives at the bombed places.

The same observations were also made at Nagasaki by Dr. MASUYAMA, in viewing the official death records at the Prefectural Police Station. The death cases on the first day were omitted, because their number was very large and it would contain some uncertain figures. The death rate since the 2nd day could be shown in a similar curve, as that of KURE cases.

The dead cases on the first day of the atomic bomb explosion, are counted in an unimaginably large number. The immediate death rate will depend upon certain specific relation. In this aspect we will discuss again the deaths from a different stand point in the following paragraph.

At Hiroshima the survey of death rates, in distances from the ground center by Dr. MASUYAMA revealed the death rates diminished according to the increasing of distance from the ground center. In the area within a radius of 0.5 km from the ground center, the mortality is practically 100%, at a distance of about 1 km around 80%, at about 1.5 km around 40 - 30%, and at about 2 km around 20 - 10%. The death rate almost corresponds to a calculated curve which is drawn as a killing energy, diminishing inversely proportional to the square of distance.

Comparing the death rates of males and females, we find they are almost equal outside a radius of 1.5 km from the ground center, but the rate of females within a radius of 1 km seems to be lower than that of males. While we were staying at Hiroshima, we often heard that under the same conditions, men died more quickly, women were more resistant. We could not believe such a story at that time. But the statistics showed a result that in the central area, the female mortality seemed to be a little lower than the male. The reason for this fact is of course unknown. The central area, within a radius of 1 km, was the place in which a tremendous number of neutrons reacted. We may be allowed to imagine that a difference of distribution of the atomic energies would cause the difference in the death rates between males and females.

Isomortality curves on a map of Hiroshima City trace almost isocentric circles. Slight deviations are recorded. Generally speaking, the curves expand a little in south and south-south-west directions and contract a little in east and south-east directions. In a south-south-west direction there are several rivers flowing into the sea, so the injuring energy would be distributed more heavily in this direction. In east and south-east directions there are many strong concrete buildings and a few hills (HIJI-YAMA and others), so the injurious energy would be reduced a little.

3. Statistics of Casualties in the Special Groups.

The army reports revealed the casualties of the troops of the CHUGOKU Regional Army (Middle Land District Army), dated on August 20, 1945. Among 7,624 soldiers in total: dead 534, missing 2,704, injured 2,713, not injured 1,668. This is valuable data because it showed the total casualties

in the first period (from directly after the bombing to the end of the second week). If the missings were counted as deaths, the estimated deaths were 3,243. Therefore, the rates of death and injured are respectively 42.5% and 35.6%. These troops were located at various places, the majority of them were in the area between a radius of 0.5 - 2.0 km from the ground center and most of the soldiers were working outdoors.

The casualties among the pupils of the elemental and high schools in the city of Hiroshima were surveyed from the beginning of September to the middle of October, 1945. The total investigated number was 16,938. Dead and missing together 4,312 (25.5%), injured 1,603 (9.5%). The mortality in each distance from the ground center, is as follows: in the area within a radius of 1 km, 82.8%, in the area between radii of 1 - 2 km, 26.0%, in 2 - 3 km area 1.9%, and in 3 - 4 km area 0.5%. This record will contain almost all of the dead cases, because it was counted in the early sub-period of the second period.

The casualties of many school parties and public service parties at Hiroshima, which were working outdoors, were also investigated. Some data will be abstracted here.

Out of 87 members of a public service party from OTAKE-town, who were working outdoors to help in evacuation of houses at 0.9 km west from the ground center, 80 died on the first day, 3 died in the first week, and the other 3 died later. The mortality 100%.

Therefore, we would like to conclude that by the direct primary effects outdoors within 1 km, the mortality is 100%, the majority of dead victims passing away in the first week.

Another 3 service parties from OTAKE-town were beside the TEHMA bridge, at 1.1 km west from the ground center. KUBA-village team was working on a river bank to transport roof tiles to a boat. Out of 106 members, 48 died on the first day, 38 died in the first week, 10 died in the second week. Another 10 persons suffered from radiation injury, but survived. The mortality 90%. MORIMOTO and NAGATO teams were taking a rest on the street. The MORIMOTO team was in the shadow of one-story wooden houses, and the NAGATO team was in the shadow of 2-story wooden houses. The majority of the members of both teams had neither burn nor wound, except a few who died by crushing under the destroyed houses. All members showed symptoms of radiation injuries after 3 weeks and many deaths occurred. In the MORIMOTO team there was an 84.0% mortality, and in the NAGATO team a 47.2% mortality.

It is clear, therefore, that at a distance of about 1 km, outdoors in some shadow, the rate of casualty will become considerably lower, but about one half of the number of persons will die of radiation injury.

Another team of OTAKE-town party was marching on a street, at a distance of 2.3 km west, toward the ground center. The total of 580 members had burns, except 3. 7 burned and 2 wounded persons died (mortality 1.6%). Others suffered from flash burns of moderate or slight grade and all healed.

Now some data of the casualties in wooden buildings will be

abstracted. The Hiroshima First Army Hospital was situated around 0.5 km north from the ground center and built of wood. Among 750 persons who were in the hospital at the explosion, only one escaped from death. The mortality was 99.9%. The majority, (around 4/5) of the dead, died early, the other 1/5 died later.

The Hiroshima Second Army Hospital was a one-story wooden building, located at around 1 km north from the ground center. Out of 402 persons who were in the hospital, 303 died, the mortality being 75.3%. Among the dead victims, 90 were immediate deaths, and 213 later deaths.

Some abstracts from the casualties in the strong concrete buildings at Hiroshima will follow. At the Banker's Club, located at 0.2 km from the ground center, 36 immediate deaths were noticed, and 28 died in 6 - 25 days after the bombing by radiation injuries. 2 survived. The mortality was 97%.

The branch office of the Nippon Bank, located at 0.4 km south-east, was a 3-story concrete building. Out of the total of 75 members, the dead victims were counted as 43 (57.4%). About 2/3 of the survivors showed symptoms of radiation injury.

There were 150 persons in the Central Telephone Office (7-story concrete building), located at 0.5 km south-east from the ground center. 183 persons were working in the CHUGOKU Electric Co. (5-story concrete building) at 0.8 km south from the ground center. In both buildings, the mortality was over 30%. Just about half of the survivors suffered from radiation injury.

The FUKUOKA Telephone Office was at a distance of 0.9 km south-east, and was a seven-story concrete building. 95 persons were working in this building. Many of them were on upper floor, which had many windows and faced toward the explosion center. 36 immediate deaths and 53 later deaths occurred, 87 deaths in total. The mortality was 93.7%.

At the Radio Station (2-story concrete), 1.0 km east, and at the Post Office Bureau (4-story concrete), 1.4 km north; the rates of dead and injured are respectively 6% and 2 - 10%. A few among the survivors complained of radiation injury.

The main building of the Hiroshima Red Cross Hospital was a 3-story concrete building and located at a distance of 2 km south from the ground center. In accessory wooden buildings many cases of deaths and injuries occurred, but in the main concrete building there were only 2 deaths. The majority of the total of 480 members in the concrete building were injured by broken window glass, window frames, furniture and equipment etc. Many glass wounds occurred. In this hospital some window curtains and chair covers were scorched and had their colors changed by heat rays. X-ray films in storage, even in a lead chamber, were affected by radioactive energies and were exposed as revealed by development. So it was estimated that a comparatively large dose of heat, light and radiation rays reached that point. Nevertheless, no single case of radiation injury was observed in the main concrete building.

As above mentioned, the grade of damages in a concrete building is surely slighter, compared with those in a wood house. But this can apply only in a well covered part of the under floors. Besides the window danger of upper floors, there are such as broken glasses.

The surveys at Nagasaki have demonstrated the same results. 50 persons were working to arrange sewage in a cave trench of a hill beside the Nagasaki Prison, just under the explosion center. 7 persons among them, who were in a deepest corner, survived. The other 43 died at their post.

As the factory district was bombed at Nagasaki, special surveys on the casualties of the factory workers were performed. The factories of the MITSUBISHI Steel Works are located at a distance of 0.6 - 1.0 km south from the ground center. Most of them were made of iron-framed, slate-roofed, and partly of concrete. Among the total employees, 1,721 on the bombed day, 883 were dead by September 15, the death rate 51.2%; by October 15, 915, 53.0%.

The MORIMACHI plant of the MITSUBISHI Arms Works was situated at a distance of 1.0 - 1.5 km south and were built partly of concrete, partly of iron-framed, slate-roofed. Out of a total of 2,200 workers, 170 were dead by September 1, a rate of 7.7%; by October 1, 600 - a rate of 27.2%. The OHASHI plant of the same works was at a distance of 1.2 - 1.7 km north, and was of a similar construction. Among a total of 6,028 employees, deaths by September 15, was 479, a death rate of 7.9%; by October 15, deaths 1,200, a rate of 19.9%. When the rate of these casualties was considered separately in concrete and iron-framed, slate roofed buildings, the casualties in the former, of course, was far smaller than those in the latter.

4. General View of the Atomic Bomb Injuries.

In the order to make clearer the general aspects of the atomic bomb injuries at Hiroshima, the Medical Parties of the Medical Faculty, Tokyo Imperial University, performed a special survey in the middle of November, 1945, selecting 28 places at random in the area within a radius of 2 km from the ground center. At each place, they selected several families, which were living there at the time of the explosion and asked carefully about all members of their families. Judging and classifying by their medical common sense, exact data concerning 898 persons was obtained. Some interesting results will be here abstracted.

There were 507 deaths among 898 persons. The death rates at each distance are as follows: In the area within a radius of 0.5 km, 98.4%; in the area between radii of 0.6 - 1.0 km, 90.0%; in the area between radii of 1.1 - 1.5 km, 45.5%; and in the area between radii of 1.6 - 2.0 km, 22.6%. The death rate in the total area within a radius of 2 km, was 56.5%. There were 358 cases of supposed immediate death. The rates of the immediate death were 90.4% in 0 - 0.5 km, 59.4% in 0.6 - 1.0 km, 19.6% in 1.1 - 1.5 km, and 11.1% in 1.6 - 2.0 km. In the total area of a radius of 2 km, the rate of immediate death was 37.0%.

Out of total 507 deaths, we could pick up 487 cases, which were proved to die on some exact date. From this data we can assume the dying

condition of the victims. The number of deaths, which occurred on the bomb day was 358, the rate of the known deaths being 73.5%. Therefore, 73.5% of all dead victims passed away on the bombed day. This fact will tell us how strong the injurious power of the atomic bomb is and also suggested to us how difficult the rescue problem is. This will be discussed later.

Among the dead victims, there were counted 413 deaths by the end of the first week, the rate to the number of total victims being 84.8%. 432 deaths occurred by the end of the second week, the rate 88.7%.

From this data we can see that about 9/10 of all dead victims died within the first period. The other 1/10 of the cases died since the second period. In the second period (the 3rd to 8th week) 48 (9.9%) died. In the third period (the 3rd to the 4th month) 7 (1.4%) died.

From the stand point of rescue, we may say that the first period itself is a most important stage. If effective rescue measures for the victims in the first period could not be achieved, the rescue rate would still stay only 10%, even though all dead victims in the second period could be helped.

The cause of 490 deaths was analyzed; 128 cases (26.2%) were dead on the first day of unknown causes. 223 cases (45.5%) were crushed, pressed and burned. The causes of their deaths were distinctly mechanical, and almost all of them were belonging to the first day deaths. 80 cases (16.3%) died clearly of flash burn. 59 cases (12.0%) died of radiation injury. If we would estimate the 128 first day deaths without clearly defined causes as mechanical deaths, the total number of the mechanical deaths would be over 70%. The problem of mechanical deaths, which has been neglectfully dealt with in the past, has become a most important one now.

Among the investigated 898 persons, there were 400 cases whose injuries were well known, 141 (35.3%) had burns, 241 (60.3%) mechanical wounds and 114 (28.6%) radiation injuries. These figures duplicate, so the total is over 400. If the 204 cases of crushed, pressed and burned deaths were counted also into mechanical injuries, the number of mechanical injuries would be 445. The rate of mechanical injuries to the investigated 604 cases is 73.6%. If 128 first day dead cases of unknown causes were counted also into mechanical injuries, the total number of mechanical wounds would be 573. The rate of mechanical injuries would be 78.3% of the 732 injured persons by various causes.

Among all of the 898 persons investigated, 45 cases had unknown causes of injury. Of the other 853 cases, 573 (67.3%) were injured mechanically. Only 121 cases were not injured at all.

By these surveys, it is known that in the area within a radius of 2 km, about 67% of all attendants were affected mainly mechanical, about 35% mainly by heat energy, about 28% mainly by radioactive energy.

The Medical Parties of the Tokyo Imperial University have done another important survey, that is, careful studies on 5,120 survived cases at Hiroshima in October and November, 1945. Some results from their report will be discussed.

Out of the investigated 5,120 persons, 3,942 were injured and 1,178 not injured. There were 1,881 burn cases, pure primary burns 867, primary and secondary burns 982. The total number of these 2 groups was 1,849 (98.3%) indicating the number of primary burns. There were 32 pure secondary burns. Out of them 17 cases were contact burns (caused by overheated or charred clothes), and 15 cases were flame burns. Among 1,881 burn cases, we have 399 (21.2%) cases with radiation injury, and 1,488 (78.8%) cases without radiation injury.

The mechanical injuries totaled 2,379.

There were 909 cases of radiation injury among them, 399 cases (43.9%) had burns, and 510 cases (56.1%) no burns.

The burns outdoors numbered 1,526 (81.0%), indoors 355 (19.0%).

Mechanical injuries outdoors numbered 466 (19.6%), indoors 1,913 (80.3%). Of the injured persons who were indoors; there were 1,576 (66.2%) in wooden houses, 293 (12.3%) in concrete buildings, and 44 (1.9%) in other places. Just the inverse relation, compared with the burned cases.

The radiation injuries outdoors numbered 421 (46.3%), indoors 488 (53.6%). Of the injured persons who were indoors; in wooden houses there were 392 (43.1%), in concrete buildings 74 (8.1%), and in other places 22 (2.4%).