CHAPTER - IV

IMPACT OF ATOMIC BOMBING
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In our world, certain events have been epoch making and certain events potent enough to have opened up new eras. The atomic bombings of Japan in the Second World War have had all these characteristics. In order to prevail with their opponents and peers simultaneously, and to frighten by their newly acquired power, derived from the realms of science and technology, the Americans used the most annihilating and cruel weapon, the Atom bomb, on an already pushed to the wall, cornered but still strutting Japan.

The impact of atomic bombings of Japan has been undiminishable in myriad ways, widespread and even larger than it could have been intended at that time. These bombings had generated world-wide revulsion and caused many painful, unbearable, and pitiful deaths. The hallmark of these bombings was that the Americans chose such victims who had no direct role in war, and were innocent.
Ironically, 'the land of the Rising Sun' was targetted with a weapon, which used the same principle and process, from which Sun itself derives it's energy. Hans Bethe in 1939 had explained that it was the nuclear reactions in which the nuclei of hydrogen atom fuses to form the nucleus of helium atoms which is the source of energy produced by the Sun. The scientists working on this theory had produced the Atom Bomb.

The effects of the atomic bombings on Hiroshima and Nagasaki were mainly because of three factors of heat, radiation and blast. The overall resultant effects of Atomic bombings can be summarized in the following categories:

(a) General effects (initial stage)

(b) After-effects

(c) Psychological effects

(d) Societal effects

(e) Economic effects

(f) Political effects

The Atomic Bombings have affected not only the Japanese but all the thinking and feeling human beings also irrespective of their colour, creeds or nationalities. The
Americans had succeeded in doing what they had initially planned for as is evident from the following extract:

The first atomic explosion would have to deliver a tremendous psychic shock to the Japanese and be sufficiently spectacular for the importance of the weapon to be recognized internationally.¹

General Effects (Initial Stages)

The most stupendous effect of the atomic bombings was the number of casualties they caused. Atomic weapons have rightly been termed as "weapon(s) of mass slaughter".² With the flash, heat, explosion and radiation human beings along with all living creations instantly died or got maimed depending upon whether they were immediately in the deadly ambit of the hypocentre or at its periphery. As for others, depending upon their distance, sustained radiation and the degree of flash burns some died instantly, many unfortunate


². The Committee For the Compilation of Materials on Damage Caused by the Atomic Bombs in Hiroshima and Nagasaki, Hiroshima and Nagasaki. The Physical Medical and Social Effects of Atomic Bombings (Trans) (Tokyo: Iwanami Shoten Publishers 1979), p.335. (Hereinafter referred to as The Committee for Hiroshima and Nagasaki.)
ones had lingering death and some of the survivors have passed on the resultant ill effects on to their next generations.

The exact number of dead and injured from the atomic explosions at Hiroshima and Nagasaki can never be known. Persons unaccounted for might have been burned beyond recognition in the falling buildings, disposed off in one of the mass cremations of the first week of recovery, or driven out of the city to die or recover without any record remaining. No sure account of even the pre-raid populations existed. However, according to the United States Strategic Bombing Survey the estimates of casualties for Hiroshima ranged between 100,000 and 180,000 and for Nagasaki between 50,000 and 100,000. The Survey estimated that at Hiroshima between 70,000 and 80,000 persons died and almost the same number sustained injuries, and at Nagasaki 35,000 died and some what more than those who died sustained injuries. The


4. Ibid.

5. Ibid.
injuries sustained can be classified as follows:

1. Atomic bomb thermal burns - (a) Primary thermal burns:
   Flash burns. (b) Secondary thermal burns: Scorched burns; Contact burns; Flame burns.

2. Atomic bomb Trauma - (a) Primary Injury; Blast injury.
   (b) Secondary Injury: Buried injury; Compression injury; Fragment injury.

3. Atomic bomb radiation illness - (a) Primary radiation illness. (b) Secondary radiation illness.⁶

At the time of the atomic explosion, most of the immediate casualties did not differ from those caused by incendiary or high explosive raids. They were victims of flash burns, falling debris and burns from the blazing buildings. The Hiroshima prefectural health department placed the proportion of deaths as follows: Flash or flame - 60 per cent, falling debris - 30 per cent, other related injuries - 10 per cent. The only outstanding difference with the conventional explosion was the presence of radiation effects which became unmistakable about a week after the

⁶ Quoted in The Committee for Hiroshima and Nagasaki, n.2, p.117.
bombing and many persons died or succumbed due to these effects. "Colonel Stafford Warren, in his testimony before the Senate Committee on Atomic Energy, estimated that radiation was responsible for seven to eight per cent of the total deaths in the two cities." However the Survey maintains that a plausible estimate of the various causes of deaths would range as: Flash burns - 20 to 30 per cent, other injuries - 50 to 60 per cent and radiation sickness - 15 to 20 per cent.

Flash Burns. The flash burns followed the explosion instantaneously. The flash lasted an extremely brief period of time (about 0.2 to 3 seconds following explosion). The radiant heat of a peak temperature travelled at the speed of light and all those who were in the open got so severely burnt that their skin was charred dark brown or black and all of them died within a few minutes or hours. The others who were partially shielded showed evidence of burns of the exposed areas almost immediately after the atomic explosion. At first there was a marked redness and the evidence of

8. The Committee for Hiroshima and Nagasaki, n.2, p.36.

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thermal burns appeared in the next few minutes or hours, depending upon the degree of burn. Many of the Japanese doctors who attended such cases reported that the burnt parts, if uninfected, healed like the normal burnt up cases and the symptoms of radiation had nothing to do with it. Similarly the formation of excess scar tissues or contractures can only be attributed to the effects of burning and later healing and not to any other specific feature of the atomic flash.

There were many cases of protection due to shielding effect of objects such as buildings, materials, objects, clothing and even another human being. In fact anything opaque which came in between the source of flash and the exposed person acted as a shield. The radiant heat travelled like a line of light and had maximum effect when falling direct and relatively less when falling on an angle or falling due to reflection. The Survey observed:

People in buildings or houses were apparently burned only if directly exposed through the windows. The most striking instance was that of a man writing before a window. His hands were seriously burnt but his exposed face and neck suffered only slight burns due to angle of entry of the radiant heat through the window.  

The degree of absorption of the radiant heat in the flash also depended upon the nature and colour of the material or object and the reflection and absorption occurred on the surface of the material while a few rays fell through. For example, much more heat was absorbed by a black cloth than white cloth. The absorbed heat raised the temperature of the material or object. The enormous energy absorbed was localized on the surface of the material or object and resulted in extremely high surface temperatures.

The Japanese Committee of Researchers observed:

In the atomic bombings of Hiroshima and Nagasaki, the ground surface at the hypocentre is believed to have reached a temperature of $3000^\circ$ to $4000^\circ$ C. The heat rays caused thermal burns on the exposed skin of people within the limits of about 3.5 kilometers of the hypocentre in Hiroshima and of about 4 kilometers in Nagasaki. Though thermal burns were sometimes seen on skin covered by clothing, the skin of those wearing white clothing, with its high rate of reflection, was relatively protected; while that of those wearing black, with its high rate of absorption, had many marked thermal burns.\textsuperscript{10}

Other Injuries. The atomic explosion and concomitantly the air-burst were several hundred meters above the ground level. In case of Hiroshima it was $580\pm 15$ meters above

\textsuperscript{10} The Committee for Hiroshima and Nagasaki, n.2, p.36.
Because of the "combination of factors at the area near the centre of the explosion the casualty effects of blast are hard to single out". Even directly under the explosion which was almost half kilometer above the ground level, technically people were several hundred meters away, therefore, there were hardly any true blast effects. The blast effect was lateral towards the periphery of the affected zone and its intensity petered off. The blast normally acts in a manner in which arms or legs or other body parts get torn away from the body. The ear-drums get ruptured. But herein there was hardly any case of the type -

Among 106 victims examined by the Japanese in Hiroshima on 11 and 12 August, only three showed ruptured ear-drums... Only at Nagasaki were there reports of over pressure in the shock wave. Some of the dead were said by survivors to have had their abdomens ruptured and intestines protruding; others were reported to have protruding eyes and tongues. 13

The Allied investigators, in general, tended to discount such reports as a result of blast effects. They pointed out

11. Ibid., pp.22-29.
13. Ibid.
that such symptoms were due to injuries by the falling, flying and tottering debris.

Thousands of people were buried under the falling buildings as these got collapsed almost immediately with the blast. Most of the people who could not extricate themselves died either due to injuries or fires. Many others who were able to find their way out, died because of the gravity of their injuries. The Japanese buildings were of such a design that their roofs were of heavy tiles whereas the walls and partitions were light. The flying glass caused large number of casualties even up to a distance of 15,000 feet from the ground zero. A large number of deaths in the cities of Hiroshima and Nagasaki were due to 'burning alive' of many persons who got trapped in the buildings. The secondary fires had not caused sizable burns amongst the survivors because they could move to areas of safety by instinct. The clothing of most of the persons had caught fire almost instantly with the flash and it is reported by the Survey that it was easy to put off such fires without serious injury to the skin. Many fatalities occurred due to a lack of care for those who were seriously burnt and could not be extricated from the debris.
There are no reports of deaths due to the inhaling of carbon monoxide. Such deaths had resulted in Tokyo fire raid and in the fire raid over Hamburg in Germany.\textsuperscript{14}

\textbf{Radiation Diseases}. According to the \textit{Survey} the radiation effects upon survivors were due to the gamma rays which were liberated by the fission process rather than from induced radioactivity or the lingering radioactivity of deposits of primary fission products. The pockets of radioactivity detected at Hiroshima and Nagasaki were insufficient to produce casualties in the areas where the fission products were directly deposited. Even the induced radioactivity from the interaction of neutrons with matter, caused no authenticated casualties. But the effects of gamma rays were main factors in radiation. However, the dose that resulted in a particular kind of disease had been the subject of investigation. "The estimation of radiation dose has been continued since 1952"\textsuperscript{15} and is still underway.

Those persons who were near the hypocentre but did not sustain flash burns or secondary injuries developed various

\textsuperscript{14}. Ibid., p.18.
\textsuperscript{15}. The Committee for Hiroshima and Nagasaki, n.2, p.127.
types of ailments within two to three days. Majority of them
died within two to seven days after suffering from bloody
diarrhoea. Their autopsies showed untoward changes in the
blood chemistry - almost complete absence of white blood
cells - and revealed deterioration of bone-marrow, and
severe inflammation of mucous membranes of throat, lungs,
stomach and intestines. Those who were at relatively greater
distances from the hypocentre did not initially show severe
symptoms, for about one to four weeks after the explosions.
But they definitely felt debilitated and listless just one
day after the explosion and suffered from vomiting and
nausea. This stage was followed by a feeling of well-being,
followed once again by nausea, vomiting, loss of appetite,
lassitude and general discomfort. The Japanese physicians
attending upon such cases noted that those who rested for a
longer time, or exerted less, following the cessation of the
initial symptoms, had a longer period in between before the
symptoms such as inflammation of the gums, mouth and pharynx
appeared. Generally, in such cases after the onset of
aforesaid symptoms, within 12 to 48 hours, fever became
evident. In many cases the fever was up to 100° Fahrenheit
and remained only for a few days but in some cases it went
as high as 104° to 106 Fahrenheit. "In severe cases there was a staged elevation of body temperature within five to seven days and continued until death. In slightly milder cases both nausea and vomiting soon ceased and temporarily entered into a latent phase without fever. Fever, however reappeared, together with epilation and purpura."16 When the fever subsided due to the restoration of white blood cell count the patient regained his feeling of good health and well being but it could relapse at any time.

There was no end to the radiation diseases which kept developing with the passage of time and depending upon the distance of the victims from the hypocentre at the time of atomic explosion. The other symptoms were the destruction of white blood corpuscles, loss of hair, gangrene and "inflammation of the mouth and the pharynx, ulceration of the lower gastro-intestinal tract, small livid spots resulting from escape of blood into the tissues of the skin or mucous membranes and larger haemorrhages of the gums, nose and skin."17

17. USSBS, Atomic Bombs on Hiroshima, Nagasaki, n.3, pp.18-19.
The other ailment which markedly affected the victims was 'epilation' or the loss of hair. It is reported that epilation commenced four to five days after the explosion but generally it began by the middle of the second week in the early cases and fifth week in the late cases. This condition occurred most frequently on the fourteenth and fifteenth day and was mainly confined to the scalp, armpits, beard, pubic region and eyebrows. "The incidence of epilation was 41.4 per cent among the survivors and 54.8 per cent among the fatal cases."\(^{18}\) In survivors, however, there was regrowth of the hair after about two months. The microscopic study of the epilated body areas revealed that the cause of the hair loss was an atrophy of the hair follicles and that hair-bulbs were not attached to the hair that fell off.

By the sixth or seventh day of the explosion, in those who were exposed at a closer distance, there was a marked decrease in the white cell count, many victims showing further decrease in the number of white blood cells by the time of death. A decrease in the number of white blood cells

\(^{18}\) The Committee for Hiroshima and Nagasaki, n.2, p.131.
corpuscles in the blood was almost constant accompaniment of radiation diseases, existing even in mild cases. The degree of leukopenia\(^{19}\) was probably the most accurate index of the amount of radiation a person was exposed to. In more severe cases the white blood cell count was less than 1500/cmm. In the milder cases white blood cell count ranged between 3000 to 4000 and there was degeneration in the bone-marrow. Bone-marrow puncture was carried out in some cases by the Japanese physicians and the marrow was found almost devoid of haemoblasts showing an extreme condition of myelophthisis.\(^{20}\)

Radiation affected the reproductive functions since spermogonia of the testis and follicular cells of the ovary are radiosensitive. Sterility was common in Hiroshima and Nagasaki in the surviving victims who were affected by radiation or had the black-rain fallen over their bodies.

"Sperm counts done in Hiroshima under American supervision

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19. The normal white blood count averages 5000/cmm to 7000/cmm in a person. Leukopenia is indicated when this count is 4000/cmm or less.

20. Haemoblasts are cells from which it is assumed all other blood cells derive and myelophthisis is a reduction in production of blood cells by bone-marrow.
revealed low sperm counts or complete aspermia for as long as 3 months afterwards in males who were within 5,000 feet of the centre of the explosion." Later, surveys revealed that although there were a few cases of sterility, the majority became almost normal within five years. The effects of radiation on pregnant women were marked. The women who were within 3000 feet of the ground zero and in various stages of pregnancies had certain miscarriages and women who were up to 6500 feet had either miscarriage or gave birth to premature infants, who died shortly after birth. Amongst the pregnant women who were "between 6500 and 10,000 feet, about one-third have given birth to apparently normal children. Two months after the explosion, the city's total incidence of miscarriages, abortions and premature births was 27 per cent, as compared with a normal rate of 6 per cent."  

Menstrual disorder was the most prominent symptom appearing right after the explosion. The Tokyo Imperial University team had carried out a survey until November 1945 on 504 women who were exposed to the atomic bomb in Hiroshima. According to their findings, 71.6 per cent who

22. Ibid.
menstruated regularly before the explosion showed menstrual disorders after the exposure. The incidence of abnormal menstruation correlated with distance from the hypocentre -

Examination of the relationship between menstrual disturbance and various injuries revealed that the former occurred frequently in patients with radiation illness and occurred less with thermal injury, trauma, and with no symptoms, in that order. Approximately 78 per cent of those women with abnormal menstruation returned to normal by March 1946. 23

After-Effects

The atomic bomb explosions not only caused immediate and vital damage and largescale deaths but also resulted in intermittently delayed effects which began to appear after certain periods of latency. Even today these effects have not really come to an end. These bombings not only brought tragic and horrible injuries to the exposed but also hindered the basis for the reparative and regenerative processes. "The whole body irradiation injured the nuclei of the cells and their component DNA (deoxyribonucleic acid)"

and may lead to the induction of malignancies (cancer and leukemia) and to alteration of genes."\textsuperscript{24} Unlike the usual war damage and injury, the atomic bombs' thermal radiation, blast and radioactivity causing massive irradiation have had many after-effects and may continue to do so in generations to come.

Besides the deaths caused due to blast effects, thermal radiation and large doses of radiation, there have been many delayed effects. In general course, the condition of the victims was divided into four stages\textsuperscript{25}:

(a) \textbf{Stage I.} A large number of casualties occurred immediately after the explosion to the end of the second week. Almost nine-tenth of the fatal cases died during this stage.

(b) \textbf{Stage II.} The moderate injuries caused by radiation were encountered from the beginning of the third week to the end of the eighth week and the remaining fatal cases of stage I or one-tenth died during this stage.

(c) \textbf{Stage III.} This stage commenced from the third month to the end of the fourth. All symptoms from injury showed

\textsuperscript{24} Ibid., pp.114-16.

\textsuperscript{25} Ibid.
some improvement. A few cases, however, turned fatal due to complications. It was presumed that the course of the atomic injury had come to an end as those suffering had recovered to a manageable degree.

(d) Stage IV. This stage refers to the delayed effects which started coming to the fore after about five months and later. These comprised overgrowing skin scars, blood disorders and psychoneurological, reproductive genetics' and many other disorders.

**Keloid.** The majority of the flash burns sustained by persons within 2,000 to 3,000 metres from the hypocentre, initially got healed in a short time, with the formation of simple thin scars. However, after two months or more, they altered to become keloid - an overgrowth of scar tissue on the wound surface. The highest incidence of keloids was found between 61 and 90 days from the date of injury. Keloids developed more frequently in females than in males - females 74.3 per cent, males, 62.0 per cent and most commonly in teenagers, especially in males. The majority of those who developed Keloids were those who sustained thermal
burns at a distance of 1.6 to 2 kilometers from the hypocentre. 26

The discussion amongst the scientists has focussed on whether thermal rays or radiation itself acted as a main cause for the development of the keloids. The American scientists are of the opinion that Keloids cannot be regarded as a special after effect of atomic bomb injury whereas the Japanese scientists, who actually treated and investigated the cases of the atomic bomb survivors suffering from keloids have reported an intimate relationship of the development of keloid with the exposure to the atomic bomb explosion, resulting from primary thermal burns within 1.5 to 3 kilometers of the hypocentre. It is noteworthy that many of these keloids, of such cases, became prominent from six to fourteen months later and subsided with the lapse of time. 27

Blood Disorders. The radiation in the atomic bomb explosions greatly damaged the functions of haemotopoietic organs such as bone-marrow, lymph node, lymphatic tissue of spleen resulting in many blood disorders. In the large doses

27. Ibid., p.194.
of radiation absorbed by the human body many blood cells were totally destroyed - the patients who survived showed various symptoms originating from the decrease of red and white blood cells which resulted in deterioration of vital defense mechanism and anemia. Many other diseases such as leukemia, tumours and haemorrhagic ailments developed due to the resultant blood disorders. These disorders were a matter of life and death in the early stages of the explosion. However, those who survived showed a gradual improvement after about two months.

The haemotological findings observed in the survivors, one and two years after the explosion, were reported by the Kyoto University team. The examination of the patients who complained of general malaise, palpitation and dizziness revealed reduction of red and white blood cell count, an inefficiency of bone-marrow, and low haemoglobin. In due course of time many persons were able to recuperate. However, in some cases an irreversible injury remained in the megatopoietic cells or haemotopoietic tissue or organ after the atomic bomb injury and later developed into blood disorders such as Leukemia, multiple myeloma, malignant lymphoma, polycythemia vera, myelofibrosis and aplastic
These blood disorders are considered to be related to exposure to the atomic bomb's radiation. The majority of victims partially recovered after about one year, the reasons for other victims who have been taking time to recover have been ascribed to differences in the radiation dose, to the degree of thermal burns and trauma, to the presence of other complications, to the individual vitality or lack of it, and to the post-war living conditions. The incidence of fatalities was certainly higher amongst those who were close to the hypocentre. In the recent past, with the availability of new methods of examining the blood constituents unusually abnormal cases

28. Haemotological Disorders:

(a) Polycythemia vera: a slowly progressing condition in which there is an abnormal increase in the production of blood cells, increased red cell count, increased white cell count, increased platelet count in peripheral blood, an increased circulating blood volume - a neoplastic disease of the bone-marrow.

(b) Myelofibrosis - a chronic progressive condition in which there is an abnormal proliferation of blood elements and also of fibroblasts forming the supporting tissue of the bone-marrow.

(c) Aplastic anaemia: A chronic haemotopoietic insufficiency that involves a marked drop in production of white cell, red cell, and platelet series.
are still found in the atomic bomb survivors. A number of surveys by physicians and scientists have, however, reported a gradual decline of the characteristic blood disorders.

**Ocular Lesions.** The ocular lesions, which directly followed after the exposure to the atomic bomb explosion, may be described as (a) direct injury immediately after the explosion, (b) partial lesions of atomic bomb radiation illness, and (c) delayed effects.\(^2^9\)

According to the Clinical Report on Ophthalmological disturbance due to Atomic bomb in Hiroshima (1953) collected by Fukuoka and Nita, "the injuries encountered immediately after the explosion were thermal burns, especially of the eyelids; mechanical injuries of the eye by blast, ocular trauma from glass splinters and other foreign bodies, and lesions of cornea, conjunctiva and retina from flash."\(^3^0\) The ocular lesions accompanying atomic bomb radiation illness also resulted from anaemia, haemorrhagic tendency or haemorrhage and infections. Beside the so called atomic bomb

\(^{29}\) The Committee for Hiroshima and Nagasaki, n.2, p.203.

\(^{30}\) Quoted in Ibid., p.203.
radiation cataract, deformation of eyelids from scar-
following cure of thermal burns, and subsequent changes of
the cornea and conjunctiva are all after-effects.\textsuperscript{31}

The lense of the eyes are particularly sensitive to
radiation, compared to other tissues, and therefore atomic
bomb cataract was the most striking after-effect which was
noted in Hiroshima and Nagasaki. In cataract, the ocular
lense of the eyes becomes opaque. The cases of atomic bomb
laract were discovered and recorded by H. Ikui in 1948
(Hiroshima) and by K. Hirose and S. Fujino in June 1949
(Nagasaki). There were many other reports made by D.G.
Cogan, S.F. Martin and S.J. Kimura (1949), Dodo and S. Toda,
T. Tokunaga, Y. Masuda and Masuda and Y. Shoji, S. Sugimoto
and by surveys and investigations made by the Atomic Bomb
Casualty Commission.\textsuperscript{32}

The cases of atomic bomb cataract appeared slowly after
the exposure. The severe cases had, however, come to light
just after ten months. The lenticular opacity occurring
after the radiation progressed slowly for a long time and
then stopped unlike senile cataract. In the degree of the

\textsuperscript{31} Ibid.

\textsuperscript{32} Quoted in Ibid., p.203.
severity of the cataract, factors such as age at the time of exposure, distance from hypocentre, shielding conditions and other symptoms of acute radiation illness were considered important. The limit of the distance from the hypocentre at which atomic cataract could occur was considered by various investigations to be 1.8 kilometers. It has also been established that the exposure to atomic bomb radiation accelerated the ageing of the eyes and affected adversely their accommodation functions.

Psychoneurological Disorders. The powerful atomic bomb explosions at Hiroshima and Nagasaki suddenly brought in a catastrophe for persons not only of different strata but for different age-groups as well. Psychoneurological disorders became the fate of many, who barely survived after being injured personally, having gone through the agony of facing death. It was shocking to have faced sudden injury and becoming eyewitness to the wasting away of the near and dear ones. The psychosomatic scars of this invidious catastrophe remain at the back of their minds, even in children born of mothers who were exposed to atomic bombings. "The mere fact of having been exposed to the
atomic bomb led to various disorders of the mind and body, symptoms, and complaints and would change psychogenic conditions. 33 Many of the specialists did not study these after-effects and termed them merely as routine psychosomatic orders.

The psychoneurological disorders such as vegetative neurosis, vegetative dystonia can be attributed to atomic explosions. In a study carried out by T. Nishikawa and S. Tsuiki (1961), it was pointed out that the cases of neurosis were either caused by psychogenetic factors or by functional disorder of brain or body due to radiation. In the tests carried out on school-going children of Nagasaki (1952), it was found what the degree of weariness, ability to do mental work, academic ability and intelligence were directly affected by the distance from the hypocentre. Those who were in utero at a distance of two kilometers had neurological abnormalities of varying kinds.

The sudden mental shock and acute stress have had many after-effects exhibiting in the form of certain psychoneurological disorders such as neurosis, crucial emotional

33. Ibid., p.243.
excitation, poor memory, generalized fatigue, lack of spirit, a tendency to introversion, insomnia and many other diseases induced by the degenerative disorder of the psychoneurological system.

**Disturbances in Reproductive Functions.** The atomic explosions seem to have wrought disturbances in the reproductive functions of the Japanese males as well as in the females, in the cities of Hiroshima and Nagasaki. In males there was an initial loss of libido lasting up to two to three months after the explosion. The Tokyo Imperial University Team carried out an investigation of the spermatozoa with 124 cases from October to mid November 1945. It was found that the number of spermatozoa had decreased in proportion to the victim's nearness to the hypocentre. Almost one-third cases were rendered sterile and the degree of decrease in the sperm count was particularly marked in persons who were under the age of twenty and above forty years.

In May 1946 twelve men within the age of twenty were examined for spermatozoa count. Out of these, six were totally devoid of spermatozoa, three had fewer than 1000 count, one between 1000 and 5000 count one between 5000 and
10,000 count and only one over 10,000 count. The persons who were exposed within 1.5 kilometers of the hypocentre had fewer spermatozoa. A study carried out by M. Okishi, S. Asakura and Kaseki in 1953 brought out the relationships between distance from Hypocentre and the count of spermatozoa and also its relationship to the age of a male and his resultant spermatozoa count. The following tables (1 and 2) reveal the same:

Table - 1

Relation Between Distance from Hypocentre and Counts of Spermatozoa, Hiroshima

<table>
<thead>
<tr>
<th>Counts of spermatozoa</th>
<th>Distance from Hypocentre (in km)</th>
<th>Total Men examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5,000</td>
<td>0 to 1.0</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>1.0 to 1.5</td>
<td>13</td>
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<td>1.5 to 2.0</td>
<td>8</td>
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<td>2.5 to 3.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3.0 to 3.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>43</td>
</tr>
<tr>
<td>5000-10,000</td>
<td>0 to 1.0</td>
<td>0</td>
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<td>1.0 to 1.5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1.5 to 2.0</td>
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<tr>
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</tr>
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<td>2.5 to 3.0</td>
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</tr>
<tr>
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<td>3.0 to 3.5</td>
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<tr>
<td></td>
<td>Total</td>
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<td>10,000 or over</td>
<td>0 to 1.0</td>
<td>3</td>
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<td>1.0 to 1.5</td>
<td>15</td>
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<tr>
<td></td>
<td>Total</td>
<td>71</td>
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34. Quoted in ibid., p.152.
Table - 2

Relation Between Age and Counts of Spermatozoa, Hiroshima

<table>
<thead>
<tr>
<th>Counts of Spermatozoa (Per cm³)</th>
<th>Age in years</th>
<th>Total Men examined</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Under 20</td>
<td>21-30</td>
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<td>0-5,000</td>
<td>13</td>
<td>13</td>
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<td>5000-10,000</td>
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<td>2</td>
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<tr>
<td>10,000 or over</td>
<td>11</td>
<td>31</td>
</tr>
<tr>
<td>Total Men Examined</td>
<td>26</td>
<td>46</td>
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</tbody>
</table>

It is pertinent to mention here that the majority of the cases of sterility returned to normal condition in about five years.

The women in Hiroshima and Nagasaki were traumatically affected by the atomic bomb explosions. Menstrual disorder was the most prominent traumatic symptom amongst them. Their abnormality in menstruation was also directly proportional to the distance from the hypocentre. As already mentioned the Tokyo Imperial University Team had carried out a survey until November 1945 on 504 women who had been exposed to atomic explosion in Hiroshima. The abnormality in the menstruation was studied by Y. Mitani et.al. in a report

35. Ibid.

168
entitled "Effects of Atomic Bomb Exposure on Female Sexual Function in Hiroshima" (1953). The relevant data collected by the team of the Tokyo Imperial University is given out in the following:

**Table - 36**

<table>
<thead>
<tr>
<th>Distance from Hypocentre (km)</th>
<th>Regular Menstruation</th>
<th>Irregular Menstruation</th>
<th>Number of women examined</th>
<th>Total women examined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
</tr>
<tr>
<td>0-0.5</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>0.5-1.0</td>
<td>6</td>
<td>20</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>1.0-1.5</td>
<td>28</td>
<td>73</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>1.5-2.0</td>
<td>42</td>
<td>81</td>
<td>31</td>
<td>6</td>
</tr>
<tr>
<td>2.0-2.5</td>
<td>39</td>
<td>35</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>2.5-3.0</td>
<td>19</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3.0-3.5</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.5-4.0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.0-4.5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4.5-5.0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Women Examined</td>
<td>143</td>
<td>221</td>
<td>77</td>
<td>18</td>
</tr>
</tbody>
</table>

**Note:** Figures in the parentheses are percentages of total number of women examined.

I Amenorrhea right after exposure
II Amenorrhea after one or two menstruations
III Amenorrhea after two or more menstruations
IV Early menstruation, prolonged menstruation or irregular bleeding

It must be mentioned here that the women exposed to radiation, depending upon their distance at the time of atomic explosion, showed symptoms of menstrual disturbance in that proportion. The data explaining the menstrual disturbance in relation to distance from Hypocentre in Nagasaki was compiled by K. Kaida of Kyushu Imperial University. Table No. 4 gives out the 'Changes in Menstruation and Amenorrhea in Relation to Distance' from the hypocentre of the atomic explosion in Nagasaki:

Table - 4

<table>
<thead>
<tr>
<th>Distance from Hypocentre (kms)</th>
<th>Number of women</th>
<th>Changes in Menstruation Number</th>
<th>Percentage</th>
<th>Amenorrhea more than 1 month Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.9</td>
<td>11</td>
<td>11</td>
<td>100.00</td>
<td>9</td>
<td>81.8</td>
</tr>
<tr>
<td>0.9-1.8</td>
<td>80</td>
<td>70</td>
<td>87.5</td>
<td>60</td>
<td>75.0</td>
</tr>
<tr>
<td>1.8-2.9</td>
<td>50</td>
<td>33</td>
<td>66.0</td>
<td>31</td>
<td>62.0</td>
</tr>
<tr>
<td>2.9-3.9</td>
<td>83</td>
<td>41</td>
<td>49.4</td>
<td>27</td>
<td>32.5</td>
</tr>
<tr>
<td>3.9 and more</td>
<td>102</td>
<td>26</td>
<td>25.5</td>
<td>18</td>
<td>17.6</td>
</tr>
<tr>
<td>Total</td>
<td>326</td>
<td>181</td>
<td>55.5</td>
<td>145</td>
<td>44.5</td>
</tr>
</tbody>
</table>

The effects of radiation appear to have advanced the age of menopause in women. Those who were exposed to radiation commenced their menopause at the mean age of 47.35 years as compared to 48.5 years in the unexposed. Those who developed the radiation symptom started their menopause at the age of 45.9 years.

Many women were pregnant at the time of the atomic explosions. If they did not abort and survived the normal duration of pregnancy, they gave birth to such children who were exposed in utero. Such children as grown ups have had many neuro and other mental retardation disorders. "One who meets these unfortunate microcephalics, has no alternative but to consider the atomic bomb attack on Hiroshima and Nagasaki to have been a crime".38

**Genetic Disorders.** Since the atomic explosions in Hiroshima and Nagasaki, almost three generation have come up so far. In the past 50 years considerable research has been carried out on the aspects of determining the genetic disorders consequent to the irradiation.

The people who were exposed to radiation in Hiroshima and Nagasaki revealed various types of "chromosome aberrations". The Committee's findings have suggested that "with the lapse of time, cells with radiation-induced chromosome aberration, could have proliferated in the body to form a group of aberrant cells" and are potent to have biological and medical significance. "Genetic effects on the offsprings following irradiation are manifested by injury to the parental germ cells (sperm, ova, and their precursor cells) in the gonads."

Many surveys undertaken by experts so far, to determine as to whether the genetic disorders were triggered by the irradiation have not provided a conclusive proof of the same as the human body gets rid of abnormality through various means. It may explain as to why spontaneous abortions or abortions from unrecognizable causes occurred, in those who were exposed to radiation. In other words, through the mechanism of natural selection, most genetic damages might

39. Chromosome is known to be a carrier of human gene in the nucleus of cell and its basic chemical constituent is called DNA (Deoxyribonucleic acid).

40. The Committee for Hiroshima and Nagasaki, n.2, pp.315-16.

41. Ibid., p. 320.
have disappeared before they were recognized. However, in a study carried out by Tajima in 1972 dealing with the theoretical aspects of radiation genetics, it was brought out that the offsprings affected by genetic disorders; triggered by radiation; were increased by 11 to 16 per cent in Hiroshima and by 5 to 7 per cent in Nagasaki, when compared with the rate of abnormal offsprings born to the non-exposed. According to Tajima "there is a possibility of spreading recessive traits in the heterozygous conditions in the subsequent generations" and the period of three generations may be considered to be a very short interval in the realm of human genetics.

The atomic bombings at Hiroshima and Nagasaki resulted in lingering and delayed after-effects as well. Thermal injuries, radiation illnesses, keloid, leukemia, anemia, blood disorders, cataract, and different kinds of cancers are so far the obvious after-effects. There is a strong possibility of the abnormalities being in the birth rate, sex ratio and development, besides existing in the genetic code. All those who were exposed to the atomic bombings and

42. Ibid., p.327.
their coming generations have to perforce bear the consequences.

Psychological Effects

Atomic bombs were the most destructive weapons introduced in the arena of warfare. The Japanese had perseveringly borne fragmentation and incendiary bombs prior to these. The incendiary bombs had burnt Japanese homes, work places, and fields. These bombs had started myriad 'fires'. However, the Japanese were learning fast as to how to fight such fires and to minimize the damage. Psychologically, the Japanese had already been weathered to a great extent. But in the loss of millions of men, women and children at Hiroshima and Nagasaki the Japanese government's response was exceedingly passive. "The government gave neither any reports on radiation casualties nor the help the people desperately needed. It simply left them to fend for themselves."\(^{43}\) It would have been appropriate for the government to care for the victims as it did for its military personnel: but it lacked such concern,

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43. Ibid., pp.339-40.
and made no survey preliminary to rendering any required aid. The sordid effect of such a colossal destruction and mass deaths and a monumental carelessness on the part of the government resulted in psychological shocks which intensified further victims' sufferings. They were burdened with an inconsolable pithy and an eternal anguish which can be described in phrases such as 'keloid of the heart' and 'leukemia of the spirit'.

The experience of Atomic bombs was both heart-rending and mind-shattering even for the victims who have lived through it. The victims have been carrying "enormous, abhorrent, and life long impression in their minds and memories". 44 Those within one kilometer of the hypocentre, at the time of the bombing and who somehow survived have been wondering as to how they involuntarily exhibited queer characteristics. Children having abandoned parents may be understandable, husbands having abandoned wives or vice versa might still be understandable but mothers forsaking their own children in the moments of trauma is naturally jolting. The psychological after effects in all the categories have been untoward. What else could have been

44. Ibid., pp.484-5.
The state of those who were suddenly made to face the most sweeping and scarring destruction in the history of mankind?

The atomic bomb victims had undergone such an enormously abhorrent shock that they were robbed of their psychological equilibrium. The severity of the shock, their disabling conditions, inhumanity in the crudeness of warfare, apathy of the society, callousness of the governmental institutions, lip service of those who feigned to care, and compulsions of a dependence upon others, along with being the show pieces of humanity have created such psychological tremors in their personalities that even with a passage of time they are not psychologically normal nor are they understood. It is incomprehensible to many of them also as to why they or all those whom they saw dying, were made to go through such pains, troubles and tribulations: as to why the nations still continue to stock the deadly weapons and as to why anyone else anywhere in the world may at any time befall their fate.

Yoshitoshi Kubo, in his "Study of Human Behaviour Immediately after the Atomic Bombing of Hiroshima" (1952), described the metamorphosis of the psychological condition of the victims. According to this study the victims made
various responses to the explosion of the bomb which acted as an external stimulus. The first set of stimuli was triggered by bomb's flash, blast and the initial collapse of buildings. The people, depending upon their distance from the hypocentre, were startled, fell down and covered their heads or eyes with their hands and instantaneously turned their bodies either away from the flash or swiftly stood up to face the illuminated area. As the flash was immediately followed by the blast, many persons were blown off, like pieces of paper, glass and furniture. Huge buildings and structures were demolished in a jiffy. In the fastly ensuing situation many people were so nonplussed that their minds went totally blank and some of them lost their consciousness. Those who regained consciousness, wondered if they were alive, whether something hit them or fell upon them. They were now thrown off psychologically as well and were mortally afraid of their surroundings. They tried hard at fleeing from the affected area.

The second set of stimuli was onset by the sight of those who were severely burnt and injured, and by the sight of all around leaping flames, and the sight akin to an utter devastation on all the sides. If still alive and conscious the victims began to view themselves and their surroundings
now more objectively. And, in the survival triggered response an utter chaos followed and the feeling of having avoided direct hit filliped it further. An instinctive urge to flee from danger overtook everybody. People lost their capacity to make clear judgments and were unable to select clear goals in the melee. A crisis mentality upsurged generating a state of mind giving birth to all kinds of mistakes and provoking sheer panic. An increased awareness of dangerous and fearful surroundings stimulated bewilderment and perplexity.

The entire set of stimuli was replete with involuntary exclamations in response to cries of pain in horror and by the sight of gruesome scenes. The sense of time was almost lost. The terrific images and spoken words were intermingling and enhancing agonies. The atmosphere was reverberating with expressions such as 'It is like hell', 'All these wounds and burns', 'the rapidly spreading and all engulfing fires', 'the roar of American planes', 'repeated explosions caused by the fire', 'that way is dangerous', 'another raid is coming'. The deafening, mystifying thunder of the mushroom cloud followed by the fall of an unforeseen black rain was maiming and incapacitating. People were
leaving the city listlessly, some were overwhelmed with the set of stimuli, while others just followed on to the fleeing crowds. People on their seemingly endless flight, at times, stopped or stumbled to catch on an elusive rest or they halted wherever they felt they could move no further. People eventually reached some place they felt to be safe where they rested and slept and also received food and treatment - at last they began gradually to recover their psychological functions.45

The horrific experience was planted indelibly over the minds of the victims and on to their very beings. Henceforth, they thought of themselves to be different from all others, having temporarily lost their normal mental faculties, having slid down to a kind of awe induced animal behaviour. The magnitude of various external stimuli was enormous. A tremendous confusion and chaos were imposed on each individual's powers of discernment and judgment. "From the currently more common psychological scheme of stimulus - subject - response, the middle function was

blocked out by a dehumanizing impact that robbed the victims of their psychological functions." 46

The atomic bomb victims found it increasingly difficult to cope with the societal set-up and also with life itself. Their anxieties about appearance, health, personality and very being now obsessed them and hindered the process of their merging with the stream of life. They developed a drifter mentality and an introverted outlook. Most of them would regularly experience mental breakdowns, mental disequilibrium, and the fear of death would haunt them whenever they would get into bouts of pessimism or stress due to their precarious livelihood. The severe shock that the bomb victims had experienced immediately after the bombings had to have lasting psychological influences upon them.

"Most victims however began to recover their mental capacities, especially as they got out of the city temporarily and received treatment for their wounds and burns." 47 It has been reported that from a week to three weeks after the bombings, the symptoms of radiation offset the recovery as new types of illnesses were overtaking them.

46. The Committee for Hiroshima and Nagasaki, Ibid., p.487.
47. Ibid., p.488.
A very high fever, haemorrhaging of gums, throat, nose, and womb; loss of hair; and general malaise (including both physical fatigue and psychological numbness) hindered their recovery process and when they got over it all, and managed to survive to be part of the human society; wayward anxieties and psychological disturbances have never left them. Their daily diaries, letters, paintings and writings are a vocal testimony of what nuclear weapons can do to human beings, whom death might spare but life will not let live - a "life" where past haunts and future is certainly uncertain in view of stockpiled nuclear weapons in the world at large. Those who have survived till date or those who have been born after having been exposed in utero definitely have taken to life not merely as an expression of their instinct for survival but because of their hysterical faith in humanism and humanity's hyphenated rejection of nuclear weapons.

Societal Effects

The most crucial impact of the atomic bombings was in the consequent disruption of an entire network of community life, systems and structures and also certain social organs built-up over the last so many years. In the flash,
explosions, fires and the resultant chaos people lost not only parents, children, kith, kin and neighbours but even their places of work. The extensive physical and human losses produced social disintegration and affected societal aspects of human existence. The following Table delineates the impact of heat, blast and radiation.

Table - 5

<table>
<thead>
<tr>
<th>Destruction of life and health</th>
<th>The pain of death</th>
<th>Breakdown of psychological functions</th>
<th>Destruction of Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Impact</td>
<td></td>
<td>Psychological, spiritual impact</td>
<td></td>
</tr>
<tr>
<td>(Medical, bodily injury)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakdown of Physical</td>
<td></td>
<td>Total collapse of human life</td>
<td>Breakdown of Social</td>
</tr>
<tr>
<td>conditions of life</td>
<td></td>
<td></td>
<td>conditions of life</td>
</tr>
</tbody>
</table>

The atomic bombings did not only affect the social set-up but the social structures and framework as well. Within two kilometers of hypocentre all life and property was burnt and buried and whatever links the people therein had in the society, they were perforce transmuted into ashes. "Just as the demise of the irrigation system of Mesopotamia turned once fertile fields, lands into a desert, so the cities of Hiroshima and Nagasaki were reduced to wasteland in an instant... Citizens who lost no family members in the holocaust were as rare as stars at sunrise".49

The New York Times reporter W.L. Laurence who visited Hiroshima on 3 September 1945 expressed his satisfaction with the complete destruction of the city. His concern was solely with the might of the bomb; its victims interested him only as proof of that might. This singular focus was not limited to Laurence alone, it was also in the policy of the Occupation Forces and of the United States government. The Committee records:

On 6 September 1945 the General Headquarters of the Occupation Forces issued a statement that made it clear that people likely to die from Atom bomb afflictions should be left to die.50

49. Ibid., p.6.

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On 19 September 1945 by means of a Press code censorship was imposed on all radio broadcasts, newspapers, magazines and print media. All reports, commentaries and treatises dealing with Atom bomb damages, and even those dealing with the medical treatment of Atom bomb victims were prohibited. Thus, all accounts of the bomb's damages, and victims' pitiable plight, disappeared from newspapers, magazines and academic journals.

It was only in 1965 - twenty years after the atomic bombings that the Ministry of Health and Welfare backed by a National Diet's decision conducted a survey of the conditions of the people holding Atom bombs' health books.51 It was a lopsided and sketchy survey which could not be published as it was criticized by the Atom Bomb Victims' Association and even by the persons involved in its research and investigation. In 1975 The Ministry of Health conducted another survey to highlight the conditions of the victims but it was considered incomplete. Nevertheless, the social scientists had tried to assess the social effects of the atomic bombings. In this regard from 1954 onwards serious

51. Certificate Record Books issued under the 1957 Atom Bomb Victims Medical Care Law.
research got underway and in the sixties of this century extensive studies were undertaken. However, it has not been possible to accurately delineate or piece together the victims' fading memories and oral reports. While time has not healed their gaping societal-wounds, it has certainly succeeded in concealing the vital information.

Atomic bombings were, indeed, a terrible blow for the Japanese societal system. Sufferings and the horrors caused by atomic bombs did not end with the largescale destruction. A social murk continues to haunt and handicap the affected people and their communities. This misfare appears to be in the lot of even their "succeeding generations and spread far beyond those individuals initially assaulted by its (bomb's) awesome power." 52

Economic Effects

The atomic bombs dropped over Hiroshima and Nagasaki caused unprecedented economic losses in the form of loss of wealth in the destruction of buildings, machinery, equipment, vehicles, transport, equipment, tools, furnishings, fixtures, reclaimed lands, animals, plants,

52. Ibid, p.393.
construction expense accounts and other tangible fixed assets. Property losses in Hiroshima and Nagasaki are given in the following two tables:

Table - 653

Property Losses in Hiroshima

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Estimated Loss (millions of yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>536.0</td>
</tr>
<tr>
<td>Bridges</td>
<td>8.0</td>
</tr>
<tr>
<td>Roads</td>
<td>1.5</td>
</tr>
<tr>
<td>Industrial machinery and tools</td>
<td>10.5</td>
</tr>
<tr>
<td>Railroads and rolling stock</td>
<td>15.8</td>
</tr>
<tr>
<td>Electric and gas facilities</td>
<td>10.3</td>
</tr>
<tr>
<td>Water and sewage facilities</td>
<td>6.0</td>
</tr>
<tr>
<td>Household effects and furnishings</td>
<td>286.0</td>
</tr>
<tr>
<td>Industrial Products</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>884.1</td>
</tr>
</tbody>
</table>

Table-754

Property Losses in Nagasaki

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Estimated Loss (millions of yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residences</td>
<td>41.4</td>
</tr>
<tr>
<td>Non-residential, nonindustrial buildings</td>
<td>108.0</td>
</tr>
<tr>
<td>Household effects and furnishings</td>
<td>80.7</td>
</tr>
<tr>
<td>Factories</td>
<td>150.0</td>
</tr>
<tr>
<td>Total</td>
<td>380.1</td>
</tr>
</tbody>
</table>

53. Ibid., p.388.

54. Ibid., p. 390.
The atomic bombings had burnt 120,000 houses in Hiroshima and Nagasaki. The Economic stabilization Board report of 1949 made nationwide estimates of direct and indirect war damages. Its estimate of total loss of non-military wealth is 65,000,000,000 yen (49.6 billion in direct losses). This report, however, acknowledges that detailed estimates of Hiroshima and Nagasaki are not possible. It puts their aggregate share of the total loss to be about two per cent (Hiroshima alone 1.4 per cent) that is a loss of 695,000,000 yen for Hiroshima and 281,000,000 yen for Nagasaki (August 1945 values). The Hiroshima Almanac estimates the city's losses at 763,430,000 yen (October 1945 survey). The Hiroshima survey, however, estimated the losses in the destruction of private houses (440,000,000 yen), buildings (250,000,000 yen), bridges 8,000,000 yen, roads (1,500,000 yen).55

The losses of wealth at 1977 rates based on cost of construction materials for Hiroshima run to 258,000,000,000 yen, and for Nagasaki to 110,900,000,000 yen.56 These

55. Ibid., p. 386.
56. Ibid., pp. 391-2.
figures cannot, in reality describe the amount of gross-economic loss sustained by the two cities.

**Political Effects**

The atomic bombings were required not so much against Japan who was on the brink of defeat and incapable of mounting any effective counter offensive, but these were intended to establish clearly America's post-war setting. "The tragedy of Hiroshima and Nagasaki is that utter devastation of human society stemmed from basically experimental and political aims."\(^{57}\)

The war's fury which had been visiting the civilians unaccustomed to the battlefield miseries off and on, now totally descended upon their towns squarely and blazenly. The Atom bombs, not withstanding the amount of destruction they perpetrated, were not able to singly or exclusively wring out the surrender from the Japanese who even in the face of disaster did not at once give in.\(^{58}\) The atomic bombings in any case did not fulfill the wish for total

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57. Ibid., p.335.

solution. They complicated the issue. Had the Americans showed consideration when they knew fully well that the Japanese were sending messages through the Soviet Union for securing peace there might have not been so much suffering as caused by the atomic bombings. But in the rationale of 'might is right' the atoms were exploded on the unsuspecting and undefended.

In the framework of the Air Power the use of atom bombs transformed the bomber into an ultimate weapon. The devastating damage that could be caused by a single sortie appeared "to wipe out the difference which had previously separated such targets as steel works and oil refineries from the large urban areas, housing the populations whose morale it was necessary to destroy". The Hiroshima and Nagasaki bombs by the modern standards were puny indeed. Bombing experts estimated shortly after the war that they could have produced the same level of death and destruction with 2,100 tons of conventional bombs, about half of them


incendiaries. This tonnage was well within the capacity of LeMay's fleet.

In an already ongoing air offensive nuclear-fission simply replaced high explosives and incendiaries. And, to many adherents of strategic bombing, the mushroom cloud was like the fire storm, a milestone in the realization of a doctrine, almost half a century old. To such adherents, the surrender of Japan, while its shores were still inviolable, brought in a triumphant affirmation of a dream.