

#### CHAPTER IV.

##### Problems in Contamination of the Bombed Area.

Soon after the atomic bomb dropped on Hiroshima and Nagasaki, a strange story was broadcasted from America stating that the bombed area would be contaminated by the action of the atomic bomb and no living thing might grow and live for at least the coming 70 years. Accordingly, we should study carefully, if it is true that a certain area around the ground center of the explosion is really contaminated, in such a grade that animals and plants will not be able to live there for a long time.

Since directly after the affairs, many groups of physicians - Prof. ARAKATSU and others, Kyoto Imp Univ, Prof. ASADA and others, Osaka Imp Univ, Prof. SHINOHARA and others, Kyushu Imp Univ, Dr. NISHINA and others, Institute of Physical and Chemical Research etc. - worked and studied the physical, especially the radiological sides of the problem and collected valuable data. The influence upon the animals and plants, and especially the agricultural plants was also studied by groups of biologists and agriculturists. The medical members investigated the influence upon human beings. The results of these studies have already been presented in part and will be presented in the near future separately. We would like to discuss here the problems of contamination, from the stand point of medical science.

It may be assumed from the various reports that there were remaining injurious factors for several days after the bombing, which might cause some unfavorable effects on the human body. The intensity of the contamination decreased very rapidly in several days. We would like, therefore, to believe that there was no contamination factor after one week strong enough to produce harmful effects upon the human body.

What then were the injurious factors, which might exist in the first few days? The following 2 factors should be considered, according to the results of the surveys which were done until now.

1. Injurious factor by primary fission fragments.
2. Injurious factor by induced radioactivity.

Short abstracts of the results of the investigations concerning these 2 factors will be discussed here.

##### 1. Influence by the Fission Fragments.

At the explosion of an atomic bomb, it is theoretically estimated that the powerful fission fragments will be scattered over a circle of a radius of 80 meters and the weaker fragments in a circle of a radius of 500 meters. These scattered fragments will be blown up in the next instant high into the sky by the blast, reflected from the ground, directly after the explosion, and be scattered away in a huge cloud, which can be seen even from a great distance. No fragments will, therefore, remain on the ground. Careful investigations were made, at both cities, on soil specimens taken at various places. Radioactivity was proved around the ground center, its intensity being very weak, under 10 - 20 times the natural leakage of the electroscopes which is below one hundredth of a tolerance dose. The measured radioactivity decreased rapidly in its intensity with time. It acted



upon human beings at the longest for a period of one week. Some soil specimens at the TAKASU district, west suburb of Hiroshima City (located between KOI Railroad Station and ITSUKAICHI Railroad Station, at a distance of 4.5 km from the ground center), were proved to show the same intensity of radioactivity as that of the ground center. On August 6 there was blowing a weak east-south-east wind, in a velocity of 1 - 2 meters per second. About 20 minutes after the explosion, it rained heavily at the TAKASU district. It was said the rain was black, for it made black spots on white clothes. Consequently it may be estimated that the radioactivity of this district was caused by the fission fragments, which came down by wind and rain. But its intensity was surely very weak, for we have no clear evidence yet that some biological effects have occurred to the human body.

At Nagasaki, there was a west wind and a light rain in the eastern district. Relatively powerful radioactivity was proved at the NISHIYAMA district, at least 3 km from the ground center. This district is located at the eastern foot of MT. KOMPIRA, which stands in the east side of the bombed area. The NISHIYAMA area was protected from the primary rays by Mt. KOMPIRA. In the district (south-north 2 km x east-west 3 km), soil specimens had radioactivity 200 times the natural leakage of the electroscope. A soil specimen under a gutter down spout of a house, which is located just in the center of this district was found to be about 2,000 times the natural leakage. By the physico-chemical analysis, many substances have been found which emitted radioactive energies. The half-lives of the radioactive products were varied, 42 days, 44 days, and 75 days, etc. Beta rays and gamma rays were recognized. 3 kinds of gamma rays were also noticed. Medical surveys on the inhabitants of this district were done, especially on the persons who seemed not to be affected by the primary radiation. After 2 months some persons were found to have leucocytosis. Further study is now being carried on. The first test was performed in the beginning of October, 1945, very many cases of leucocytosis (maximum 25,400 in cmm) were found among the children under 15 years of age. Among the young and adult persons some leucocytosis was also found, but no abnormality was proved among the old persons, over 50 years of age. After 5 months, in the beginning of January, 1946, the fourth test was done. Among adult and old persons, leucocytosis was found too. Now the cases of Leucocytosis among the children were decreasing. These persons with leucocytosis showed no other subjective or objective symptom or signs. The leucocytosis ranged from 20,000 - 40,000 per cmm, the maximum 48,000 per cmm.

This finding may be explained by beta and gamma rays being continuously emitted from the ground, even in a very small dose. Such a phenomenon has not ever been noticed in the field of radiation biology. It is desirable to make clearer this aspect by further study.

It was said also that similar powerful radioactivities were found at CHIGITA-town, east 32 km of Nagasaki and at SHIMABARA City, east 44 km of Nagasaki, but the further investigations revealed no evident proof of a powerful radioactivity and also no influence upon the inhabitants of both places.

## 2. Influence by the Induced Radioactivity.



At the explosion of an atomic bomb, tremendous amounts of neutrons are pushed out. It is theoretically well known that each element will be induced and turned into a radioactive element when it is struck by neutrons. Emission of gamma-rays, which are produced by neutrons striking nitrogen, is an instantaneous phenomenon. These gamma-rays may be a cause of primary radiation injuries, but they will not produce any after damage. At this time, the induced radioactivity of the elements in the human body, for instance, sodium, chlorine, phosphorous, etc., will be considered. Moreover the induced radioactivity of the elements in the ground earth and buildings, for instance, calcium, aluminum, copper, iron, silicon, sulfur, etc., will also be covered. The induced radioactivity of these elements has a very short half-life; 14 days for phosphorous and 15 days for sulfur are elements with relatively long half-lives. Others are several minutes, several hours or several days, and the radiated rays from the activated elements are mainly beta-rays. The injurious action of these radioactive energies may be, therefore, very weak. For example, if 500 grams of sodium chloride were distributed homogeneously in our body, it would be calculated that the total radioactive energies, which are emitted by radioactivated sodium and chloride will correspond to 13.8 r, until they are decayed away. If the ground earth in the central area were to have an induced radioactivity to a depth of 10 cm, the total accumulated radiation dose in 1 - 2 days would be calculated around 500 r. When phosphorous in human bone tissue becomes active and emits beta-rays, the influence upon the bone marrow can not be neglected, even though the dose of the rays is small. By the calculations of Dr. MURATI, Institute of Physical and Chemical Research, we can get the following information. The minimal dose of radioactivity, which can damage human tissue, has been estimated at 0.2 r per day in a 8 hour day. In order to obtain a dose of 0.1 r per day by the induced radiation of phosphorous of bone ashes (incompletely burned, still some black parts remaining), it will be necessary, for beta-ray emission to amount to  $1.3 \times 10^4$  per minute per gram of the bone ashes.

The results of the surveys by the members of the Kyoto Imp Univ and Institute of Physical and Chemical Research, at Hiroshima, and of the surveys by the members of the Kyushu Imp Univ, at Nagasaki, revealed the following. At both cities, the measured radioactivity of the bone tissues of the human beings and horses, which died in the area within a radius of 500 meters from the ground center, showed sometimes an amount exceeding that mentioned above. But from the bone tissue of the dead victims, outside a radius of 700 meters from the ground center, far less rays could be measured. Consequently, some persons might be affected slightly, when they entered very often in the central area within one week after the bombing, in order to remove or clear away cadavers, or to pick up or collect burned bone ashes. Beta rays were found in such small intensity that they could produce little damage. It may also be imagined that a person, who was affected relatively severely in the central area, would have severe damage to the bone marrow by a continuous radiation emitted by the activated phosphorous in the bone tissue, even though the initial effects by neutrons were not too severe. As those persons would have been, of course, injured in the first instant also by other violent energies, they would have died in the first period.

It may be quite rational, to consider such a possibility. Few investigators believe that bone marrow is damaged enough by activated phosphorous, to be a principal factor in producing a radiation injury in and



after the second period and also bringing patients into a state of lower resistance and thus having difficulty in healing of wounds. We would not like to agree with them. The surveys on autopsy materials of the dead victims in and after the second period, affected mostly outside a radius of 700 meters from the ground center revealed that a certain amount of radioactivity sometimes remained in phosphorus in the bone. The dose was calculated not sufficient to effect the bone marrow tissue, and moreover no remaining radioactivity in the tissue of other organs or blood could be scientifically confirmed.

Iron and silicon elements in a concrete building are worthy to be considered in the problem of induced radiation. It is theoretically estimated that both elements will emit certain beta rays within several days. The building of the branch office of the Nippon Bank at Hiroshima is made of concrete and located at 380 meters from the ground center. It was partly destroyed, but for the most part escaped from the fires. By the initial effects of the bomb, about a 50% mortality was recorded. Soon after the bombing many persons were sent to help and they worked and lived in a room not destroyed. After 4 - 6 weeks some of them were proved to have leukopenia (minimum 2,000 per cmm). However, in the main concrete building of the Hiroshima Red Cross Hospital, no such data was confirmed.

It is certain that for several days after the bombing a sufficient dose of induced radiation was scattered in the concrete buildings in the central area to produce damaging effects, but not enough to produce death.

#### Contamination of the Bombed Area.

All factors which should be considered in the contamination problem of the bombed area, are proved to exist only a few days, at longest one week, even though they would surely produce a certain damaging effect. The NISHIYAMA district, Nagasaki, is one of the exceptions which we should decide later by further study.

Accordingly we shall not pay any particular attention to contamination in establishing a reconstruction plan of the city. The central bombed area will be kept in the present destroyed condition for the future, as a historical memorial.

From a medical point of view, there are 2 more problems, concerned with the contamination of the bombed area. The first is that the bombed area was an unhygienic area in various ways. The second is that there prevailed some infectious diseases, combined or parallel to the outbreak of the atomic bomb injuries.

Both at Hiroshima and Nagasaki, especially at Hiroshima, all the city was totally devastated and turned into a ruin. Water supplies and sewers and all facilities of the city were destroyed. Consequently, it was a more unhygienic environment than the cities which were destroyed by ordinary incendiary bombs. We cannot say that the cities were favorable places to live even though there remained no specific contamination due to the atomic bomb. There were some citizens who would like to believe that the city was a favorable place to reside, or even to treat wounded and diseased persons, when they heard of no particular contamination. Such a misunderstanding was not desirable.

By various unfavorable circumstances, there prevailed infectious diseases, such as dysentery, typhoid fever and others. These occurred especially at Hiroshima, just after the typhoon attacks in September, 1945. These diseases were observed in combination or in parallel with the atomic bomb injuries. Some of these epidemic or endemic diseases were misconceived as an atomic bomb injury. The victims of these epi- and endemic diseases might be recorded partly as those of the atomic bomb injuries. Consequently we must be careful in treating the problem of the genesis of the secondary atomic bomb injuries.