

# The Hiroshima disaster

by Marcel Junod

(Continuation)

## IV. Japanese information

At the beginning of the afternoon, we were received by the Japanese authorities in what remained of the former police headquarters. We were offered a frugal lunch. Each guest was given a can of Japanese food: seaweed, meat and beans, and a can of mandarin oranges. A piece of brown bread, with rather a strange taste, completed this meal; for drinks, we had water. This fare showed to what extent the Japanese themselves were short of supplies.

At the end of lunch, the deputy governor of Hiroshima Prefecture made a short speech. He started by apologizing for the Governor's absence; I learned later that, while the Governor had been away for the day, his wife and two children had been killed in the air raid.

The deputy governor went on to welcome the Technical Investigation Commission and gave us an overall account of the situation. He introduced several Japanese officers who were later to describe their own experiences or those of others who had witnessed the events of 6 August 1945. He spoke with great courtesy, showing no emotion whatever. Once again, I was amazed by this politeness, almost obsequious, which smothered any trace of feeling.

We then spent several hours listening to the witnesses. Below is a summary of their accounts and of the official information that I was given. After this, I shall quote the statement of a man who seemed to me to be very objective: Mr. Dazai, head of the Special High Police of the Hiroshima Prefecture. His text was translated word for word for me.

### *Eye-witness accounts of the nuclear attack*

On 6 August 1945, there was not a cloud in the sky above Hiroshima; the south wind was barely noticeable (speed about half a mile per hour) and visibility was perfect up to ten or twelve miles.

At 7.09 a.m., the air-raid sirens sounded all over Hiroshima; four enemy B29 airplanes had entered the sector. Two of them, after turning north-east over the city, headed south and disappeared towards the Shoho sea; two others, after turning near Chukai, a central region to the south of the sector, quickly left again in the direction of the Bingo sea.

Believing that there were no more enemy aircraft in the Chugoku airspace, the military authorities gave the all-clear signal at 7.31 a.m. The townspeople, feeling reassured, then left the shelters.

Three-quarters of an hour later, at about 8.15 a.m., when the inhabitants were going to work, a sudden blinding light, pink and white, appeared in the sky; this was accompanied by a sort of shudder, followed almost immediately by suffocating heat and a blast-wave sweeping away everything in its path. When we visited the ruined station in Hiroshima, the hands of the clock had stopped at this historic moment, 8.15.

Several witnesses claimed to have heard an aircraft and seen a parachute fall, but most people had had no idea that there was an enemy plane over the city. This probably means that the aircraft which dropped the bomb was flying at a very high altitude.

In a few seconds, according to witnesses, thousands of human beings in the streets and gardens in the town centre, struck by a wave of intense heat, died like flies. Others lay writhing like worms, atrociously burned. All private houses, warehouses, etc., disappeared as if swept away by a supernatural power. Trams were picked up and hurled yards away, as if they were weightless; trains were flung off the rails. Horses, dogs and cattle suffered the same fate as the people. Every living thing was petrified in an attitude of acute pain. Not even the plants were spared. Trees were charred, leaves ripped off and grass turned yellow, shrivelled and burned.

Outside this area, houses collapsed in a whirl of beams, planks and iron. Flimsy buildings were flattened like cardboard up to 3 miles from the explosion. Those inside were killed or injured. Those who managed miraculously to get out did not escape the fire which broke out, a vast belt of flames, trapping the victims within the town and preventing help from arriving. The few who, in spite of everything, managed to get through the wall of fire, apparently to safety, generally died ten, twenty or forty days later from a delayed reaction to the mysterious and relentless gamma rays. Most of the strong structures (concrete, stonework) resisted the heat but were completely gutted by the ensuing blast.

Nearly thirty minutes after the explosion, while the weather was clear all around Hiroshima, a fine rain fell on the city for five minutes,

after which the wind rose and blew away this cloud, formed as a result of the over-heated air rising at tremendous speed and then condensing in the upper atmosphere. The wind fanned the flames which spread very rapidly, as Japanese buildings are made almost entirely of wood.

In the evening the fire died down and finally burned itself out through lack of fuel. Ninety per cent of the town of Hiroshima had been destroyed.

It was only the next day and the day after that the extent of the disaster could be assessed and relief organised, though totally inadequate. The public services were disrupted. It was the armed forces, especially the Navy, who conducted the relief and reconstruction work.

Here is the personal report by the Chief of the Hiroshima Special High Police:

*“An atom bomb exploded over Hiroshima on 6 August 1945, at around 8.15 in the morning. The centre of the explosion was above the Aioi bridge. The location is determined by the type and orientation of the damage caused to buildings; the parapet of the ruined bridge also clearly shows that it was twisted outwards.*

*“I live in Yokogawa Machi, on the river, about 4 miles from the centre of the explosion. Forty minutes before the explosion, I had just returned from a trip to Tokyo. While I was eating my breakfast, my wife was at the door receiving my luggage, brought from the station by a porter. At that moment, I saw a blinding flash of light pass through the front door of my house (its colour was similar to that of sparks seen with electric welding), and a couple of seconds later my house was completely destroyed. The whole family (my wife, two children and myself) were buried under the rubble of the house. The blast of air which immediately followed the flash was so strong that my glasses were blown off, injuring my face. Five minutes later, I managed to clamber out from under the ruins of my house and I immediately set to work to free my family. My efforts were successful and I was fortunate to find them all safe and sound. At the time of the explosion, I heard no sound but later several people living 4 or 5 miles from the area told me that they had heard a terrible explosion.*

*“After extricating my wife and children, I intended to go into the fields a few blocks away; but I saw that this was impossible as we were enveloped in thick smoke. I noticed that not only my immediate neighbourhood but also the mountains and the town were covered in a pall of smoke. Luckily, I found a way open on the north side. We forged ahead and succeeded in reaching an open space where there was a field of vegetables. On the way there I observed many people in the street, screaming, dying, and covered*

*with blood. The street was littered with wires and cables torn away by the blast and our way was barred by stones, bricks and rubble strewn on all sides. Just as we arrived at the vegetable field, I noticed that a fire had started in the centre of town. I left my family in this field and went to the Oshiba driving school, where I hired a car to go to the Kabe police station. From there, I sent several policemen and members of civil defence groups in all directions, to see if there was any route open to the town centre. I repeated these attempts several times up to 4 o'clock in the afternoon, because all roads were impassable owing to the fire and the heat. It was from the Kabe police station that I sent my first report to the Home Office (Naimusho) in Tokyo; at the same time, I issued instructions to eleven police stations located near the centre of Miroshima (Hiroshima city) and ordered them to make sure that food and medical care were given to those suffering from injuries and burns.*

*"Late in the afternoon, I was told there was a road open to Tammonin, one of the first-aid centres where the governor had ordered the police from the Prefecture to assemble. I set out with a small number of police officers and arrived at 8 o'clock in the evening. On the road from Kabe to Tammonin, I expected to feel tremendous heat and encounter fires. However, this was not the case because towards midday, all the buildings, or nearly all, had been burned down and by about 4 o'clock in the afternoon the worst of the heat had abated. As I am very short-sighted and had lost my glasses during the explosion, I could not see much around me on the way to Tammonin. However, the policemen accompanying me told me that trams had been derailed and had been thrown to the side of the road. The whole way was strewn with many corpses and people who had been burned or injured. Metal telegraph poles, bent over or broken, lay in our path; trees had been torn to shreds.*

*"When I arrived at Tammonin, the governor, who heard later that he had lost his wife and two children, was already on the spot with several other members of the government. By pure chance, the governor had been at Fuchumachi at the time of the explosion. From that moment on, the staff of the Province had organised systematic rescue operations.*

*"The next day, at 5 o'clock in the morning, we went to the Higashi police station. This is a very robust structure, and several nearby houses had been evacuated and destroyed before the atom bomb fell. The policemen belonging to this station had done their utmost to prevent the building catching fire from outside and consequently we found it almost intact. We therefore transferred the office of the prefectural government to this police station for the next ten days, and we worked and lived in the building."*

### *Material losses*

In the city, 67,650 buildings were affected, of which 55,000 were completely burned, 2,300 half burned, about 7,000 destroyed and 3,700 half destroyed.

Ninety rail carriages, eighty-seven trams, forty-four fire engines and one hundred and twenty-two trucks were completely destroyed and put out of service. All the hospitals were completely destroyed, except that of the Japanese Red Cross, whose walls remained standing but whose doors and windows, with their frames, had been torn away by the blast-wave. The furniture and technical equipment inside had also suffered enormous damage. Most of the schools, banks and factories had disappeared. The stocks of medicine, medical equipment and food were partially destroyed. Luckily, a certain quantity of medicine was saved because the authorities, as a precaution, had dispersed it in a number of depots. Ninety per cent of the telephones had been burned; only one line to the outside was more or less intact and this was repaired two days after the nuclear attack. However, communications with the outside world remained precarious for several days. The electric power stations had all burned down; luckily, in the southern part of the town, which was the least affected, the electricity supply was resumed on 7 August.

The supply of drinking water was less affected than other systems; but because of the vast extent of the damage, there was a great amount of leakage and the pressure was almost down to zero. Out of 54 fire pumps, 29 had been burned, 12 unusable and only 13 were in working order.

Only two or three of the many bridges in Hiroshima spanning the seven branches of the river Ota, were damaged. The railway and tram lines were almost entirely untouched.

### *Human losses*

On 11 August, rescue teams, composed mainly of soldiers from other areas, completely unaware of the danger of exposure to the continuing radioactivity, gathered up 32,000 corpses in the streets. This figure applies almost exclusively to those affected by direct radiation from the bomb. Many bodies were later discovered in the rubble of houses which had been ripped open or burned down. The total number of dead was later calculated to be about 80,000. Many of the injured died from their burns in hospital; thousands also died later from the delayed effects of the gamma rays.

Below are some figures showing the heavy losses among people in professions of public utility:

Out of 300 doctors	270	were killed or injured	
Out of 1,780 nurses	1,654	»	»
Out of 162 dentists	132	»	»
Out of 140 pharmacists	112	»	»

  

	Post Office employees	Officials of the prefectural government	Firemen
Dead	202	57	39
Seriously injured	188	267	48
Slightly injured or unhurt	396	254	99
Missing	859	529	64
Total:	1,645	1,107	250

This, then, was the dramatic situation with which the Japanese authorities had to cope the day after the disaster. The injured were only collected later and about fifty temporary hospitals were hastily set up either in the few buildings which remained intact or those which were only partially damaged. The number of injured was estimated to be about 100,000 but many died from the seriousness of their injuries or through lack of medical care.

### *Second part*

## Reflections on atomic fission

Physicists have already described the operating mechanism of the atom bomb in newspapers and magazines. Basically, a uranium nucleus struck by a slow neutron splits explosively, releasing a huge quantity of energy.

This is not the place to enter into technical details; we are more concerned with describing the various effects of this released energy and trying to analyse their causes. Our personal experiences were limited to Hiroshima, but we also heard accounts of the nuclear attack on Nagasaki.

It would seem, according to information we received, that the bomb, dropped on Hiroshima on 6 August 1945, exploded 600 metres above the ground, with its epicentre not far from the centre of the town. This was estimated as being more or less above the Aioi bridge, not far from the Chamber of Commerce (Shoko Kaigi-Sho). In fact, this bridge was the only one really badly damaged by the bombing; the parapet was destroyed and the tram lines with their sleepers were ripped out.

The total weight of the bomb is said to have been 500 pounds (about 230 kilos) for 7.235 pounds of uranium (about 3.3 kilos).

As Hiroshima sprawled over the Ota delta, without any change of level, the effects of the explosion extended over the whole city.

The bomb, dropped on Nagasaki on 9 August 1945, exploded 50 metres lower than the one over Hiroshima, i.e., at an altitude of 550 metres. Instead of uranium, it contained about the same amount of plutonium. The effect was apparently more violent but less widespread, because of the lower altitude. The city of Nagasaki was built over several valleys and hills, and the latter formed a protective screen against the full force of the bomb. There were fewer casualties in Nagasaki than Hiroshima: 20,000 dead and 50,000 injured.

In this second part, we shall therefore deal with the main effects of the atom bomb on individuals. In so doing, we shall bear in mind the various ways in which the atom bomb took effect and the place where individuals were at the time: in the street, in Japanese houses or in stone buildings and whether they were more or less distant from the centre of the explosion.

### **Effects of the atom bomb on individuals**

The effects apparently varied, depending on their cause, and could be divided into four categories:

1. Burning effect (skin burns),
2. Thermal effect (carbonization, deep burns),
3. Mechanical effect,
4. Radioactive effect.

#### **1. *Burning effect***

By this definition, I mean the results of irradiating and corrosive action by ultra-violet radiation, ranging from simple erythema of the skin to third-degree burns and ulceration.

The fact that some people suffered from burns on one side only would seem to prove that this action was extremely brief, a few split seconds. This is what the Americans call "flash burn". The severity of the burn did not depend on the duration of the explosion but on the distance of the victim from the source of ultra-violet rays.

## 2. *Thermal effect*

According to research carried out by Japanese experts on materials which melted in Hiroshima, it appears that the ground temperature rose to 6,000 degrees Centigrade. The thermal energy was estimated at ten to the power of twelve calories ( $10^{12}$ ).

This temperature was caused by intense infra-red radiation. The effects on human beings were suffocation, severe burns or even carbonization. The severity of the burns obviously depended upon whether the victim was directly under the centre of the explosion or some distance away. The casualties nearest the explosion were carbonized, whatever clothes they were wearing. The most widely divergent cases were observed. One of the most curious was that of a woman wearing a white blouse chequered with black stripes; the skin was burned only under the black stripes. The absorption of light rays by dark substances had raised the black material to such a high temperature that it had burned the skin on contact, whereas the white material did not absorb but reflected the rays, and this protected the skin under the white squares.

In many cases, the action of the ultra-violet and infra-red rays, although operating in different ways, were inextricably linked.

## 3. *Mechanical effect (blast wave)*

This is the well-known effect of the blast of an explosive bomb. However, in the case of the atom bomb, it is infinitely greater than anything the world has seen before. One thousand metres from the site of the explosion, the pressure was estimated to be 130 kg per  $\text{cm}^2$ , and the blast wave flattened wooden houses up to 4 miles from the centre of the explosion. People seemed to have been thrown violently to the ground. Countless accidents occurred inside houses built of wood: people were stunned, had their legs broken, etc.

On the whole, stone buildings resisted the blast; that is, they did not collapse completely, but the blast wave entered by doors and windows, causing considerable damage inside. Most of the round chimneys, incidentally, stood up to the blast, as their shape offered less resistance to the movement of air and their flexibility enabled them to withstand the blast pressure.

#### 4. *Radioactive effect*

This effect is caused by X-rays, gamma rays and neutrons. Gamma rays, capable of passing through solid bodies, definitely produced the greatest biological reaction, compared with ultra-violet rays which are more superficial. Their action is specific inasmuch as it is not short-lived like that of ultra-violet rays but lasts as long as substances remain radioactive. In Hiroshima, apparently, radioactivity remained harmful for human beings for about five days after the explosion; after that time, the effect seems to have been virtually innocuous.

Two examples illustrate this long-term danger:

People came from the country to the places where their relatives had been living, to search for them. They found nothing but ashes and ruins but then, among the rubble, they noticed some bones. These they gathered up reverently for honourable burial, holding them pressed against their chest and carried them for several hours until they reached home. A few days later, doctors noted burns on their hands and chests, clear signs of "radiodermatitis".

The branch office of the Nippon Bank, situated 380 metres from the centre of the explosion, was partly destroyed; but one wing remained intact, and some rooms containing stores (iron and silk) were spared. Several employees, who had been away from Hiroshima at the time of the disaster, returned there three days afterwards and lived for some time in these rooms. Two weeks later, they showed slight radiation-induced symptoms, including leukopenia with a count of 2,500 leukocytes. However, they all recovered.

During the testing in New Mexico, when the bomb exploded on the ground, the radioactivity had lasted very much longer—according to some publications, about a month.

All the clinical and biological symptoms observed amongst Hiroshima victims therefore constitute a syndrome which could be called "hiroshimitis". This syndrome seems to have been caused mainly by the action of gamma rays. The exact role of neutrons has not yet been established but would appear, at first sight, to be important. Individuals needed to be exposed to these rays for only a relatively short time, anything from a few seconds to a few days, depending upon the intensity of the radiation.

People affected by radioactivity may show varying symptoms. They may be suffering from all the effects of the bomb or from one or the other. For example, one person, having been treated for a broken leg, suddenly complains of anemia. Others, suffering from slight burns, develop melena (intestinal hemorrhage).

However, in most of the persons affected by radioactivity, we observed pure cases of the syndrome which I shall describe as "hiroshimitis".

Apart from this syndrome, there were a few exceptional cases of X-ray burns which appeared several days after the explosion. At first, they took the form of erythema, then developed into ulceration. No case of secondary cancer was observed.

### **The hiroshimitis syndrome**

#### *a) Clinical symptoms*

The first symptoms appeared from one to six days after the explosion. The patients felt generally weak, were pale, lacked appetite and tended to suffer nausea. It was often this lethargy which prompted them to consult their doctor or go to one of the temporary hospitals.

A few days later, the patient began to suffer from hematemesis caused by melena, and sometimes from hematuria, hemoptysis and epistaxis; then from the tenth to the fourteenth day, lung troubles started, as well as gingivitis. Small and numerous petechiae appeared on the skin. Symptoms of anemia, such as skin pallor, tachycardia and faster breathing, increased. The least infection became alarming. Cases of necrotica angina were frequent. The blood sedimentation rate was greatly accelerated and the tourniquet test was always positive. The length of bleeding time was prolonged. Sometimes a patient had a temperature without any infection; this was probably due to blood resorption and heavy suffusions. Many patients completely lost their hair, their gums receded and their teeth fell out.

#### *b) Hematological symptoms*

The rapid reduction in the number of leukocytes in the blood, in other words leukopenia, was often the first symptom to appear. This was accompanied by severe anemia, a type of aplastic anemia. The blood platelets diminished and even disappeared altogether. Sternal puncture revealed a decrease in new corpuscles. Hemoglobin fell in almost the same proportion as the red blood corpuscles.

#### *c) Morbid anatomy*

Autopsies on twenty victims, carried out by Japanese professors from the Imperial University of Tokyo, presented the same pathological

picture of the various organs as noted by Professor Tsuzuki in his experiments on rabbits in 1925. I myself saw many anatomical specimens.

To summarize, examination under the microscope revealed heavy suffusions of blood in almost all the organs: the brain, meninges, lungs, liver, kidneys, suprarenal capsules, etc. All possible reactions were noted under the microscope, from severe hyperemia to fatty degeneration and atrophy. A few rare signs of bone-marrow degeneration were observed.

The cause of death appeared to be acute aplastic anemia with severe leukopenia and the usual complications, infections, etc.

For further details, I refer readers to the work of Heinecke and Tsuzuki, which is still valid, as well as the considerable literature on the subject by American authors.

#### *d) Specific observations*

Children were more severely affected than adults but recovered faster.

Hematological examination of twenty witnesses, selected from those who had been more than three kilometres from the explosion, revealed two cases of slight leukopenia (4,000 to 5,000 leukocytes); all the other cases had normal blood counts.

The simultaneous action of ultra-violet and gamma rays seems to have been more harmful than gamma radiation alone. This was probably due, in addition to the troubles caused by burns and hiroshimitis, to the metabolism being upset by ultra-violet radiation.

One case of leukemia was recorded in Nagasaki, but this was probably pure coincidence.

### **Extent and consequences of the atom bomb on human beings in Hiroshima**

We give below the general consequences of the effects already mentioned above, in relation to the distance of the victim from the centre of the explosion.

To understand clearly, we have to ask: what was the effect of this nuclear attack in areas within a radius ranging from 0 to 3,000 metres, depending on whether the victims were:

- a) outside houses (in the streets and gardens);
- b) inside Japanese houses built of wood and extremely flimsy, or
- c) inside buildings made of robust materials (stone, concrete, etc.).

## **I. Persons within a radius of 0 to 500 metres from the centre of the explosion**

Although the real epicentre of the explosion was estimated to be at 600 metres altitude, we shall take as our reference point the place where the bomb would have presumably fallen if it had exploded on the ground.

### *Category a) : Persons overcome outside houses*

They were all affected by direct ultra-violet, infra-red and gamma radiation as well as by blast. They all died instantly.

The principal cause of death seems to have been the high temperature which developed as a result of the intense infra-red radiation—as mentioned above, this rose to 6,000 degrees Centigrade on the ground. Some also died from accidents following the blast, for example, houses collapsing, falling beams and tiles, etc. The bodies collected were often completely carbonized.

Within this first ring 1,000 metres in diameter the light rays struck straight down on streets and gardens, covering the entire area, with hardly a patch of ground unaffected. It can therefore be deduced that the victim was much more exposed, being under the most direct radiation and within the shortest path.

### *Category b) : Persons overcome inside Japanese houses*

Almost all died as a result of the triple action of temperature, radio-activity and, particularly, blast.

The wooden houses were smashed like matchboxes and what remained of them immediately caught fire.

People died on the spot, knocked senseless, burned or smashed by the blast.

### *Category c) : Persons overcome in buildings made of robust materials (concrete, stone, thick bricks, etc.)*

Almost all the persons in this category were mainly affected by gamma rays or by the blast wave which came through doors, windows and sometimes even the roof of stone houses. The ultra-violet rays, being superficial, had no effect.

The action of the gamma rays varied according to the thickness of the shield, such as outside walls, partitions, ceilings, etc. Japanese doctors were able to reconstruct scenes with persons who had suffered from hiroshimitis or who had even escaped completely, as they had

been in one of the rooms in these concrete buildings. They concluded that a thickness of at least 20 cm. of strong material (concrete, stone) was enough to form a screen against the force of radiation and so to protect human beings.

However, it is difficult to lay down hard and fast rules on this subject, as most of the victims in this category left the buildings immediately after the explosion and so were exposed to the continuing ambient radio-activity, to an extent impossible to establish.

The death rate among persons in this category c was apparently as high as 50%.

## **II. Persons within a radius of 500 to 1,000 metres from the centre of the explosion**

Category a): 80% killed immediately.

Category b): 20 % survivors, but almost all showing symptoms of delayed effects of gamma radiation.

Category c): 10% killed immediately. Of the remaining 90%, 50% had a delayed reaction to gamma-ray exposure, but the death rate was not recorded; 50% appear to have been unaffected.

## **III. Beyond the radius of 1,000 metres from the centre of the explosion**

In the area ranging from 1,000 to about 3,000 metres from the bomb's epicentre, persons seem to have been affected either by all the effects of the explosion or at least by one of them; they suffered to varying degrees, depending on how far they were from the centre of the explosion and where they were (see a, b and c above).

There are no exact statistics on this subject but, since the number of dead and injured for the whole of Hiroshima totalled 180,000, it would seem that the effect was fairly powerful in this area.

According to witnesses who were a mile or so from the centre of the explosion, there was a fairly long time-lapse between the flash, then the heat-wave and finally the blast (some seconds). Many people living on the outskirts of the town were even able to reach the shelters in the time between seeing the flash and hearing the sound of the blast wave. As a general rule, and these are rules of elementary physics, the greater the distance, the longer the interval.

## CONCLUSIONS

These lines are only intended to give as objective an account as possible of what a Swiss doctor witnessed in Hiroshima and of the information he managed to obtain from Japanese or American experts.

Two main questions seem to me to arise now that this new weapon has been used:

1. What new factors in warfare does the atom bomb bring to bear?
2. Is there any possible defence system to protect civilians from similar attacks?

### 1. New factors

These basic principles had been known for a long time; what was new was the specific use to which they were put. A relatively small bomb is capable of emitting light rays which, within a given area, are fatal for human beings in the direct path of radiation or inadequately screened.

Furthermore, the blast felt within a radius of a few hundred metres of the bombs used previously, now extends for many miles. Its force therefore seems 10 to 20 times stronger.

It should be pointed out that the effects of the killer rays, although more rapid, are considerably less widespread than those of the blast. The two types of force are together capable of destroying all signs of life over an area of several square miles in a split second.

The huge scale of such a disaster in a city partly destroys and totally disrupts public services. The continuing radioactivity is a real danger for relief teams coming in from outside or leaving the shelters, because they may also be put out of action.

### 2. Defence

#### *a) Overall defence*

Defence is a military problem which, in the final analysis, depends upon scientists and technicians. As things stand now, we are unequipped to provide any defence whatsoever, if V2s are used to carry the atom bomb. These missiles reach a speed of 2,000 to 2,500 miles per hour, much faster than the speed of sound, and nobody has yet been able to stop them.

Furthermore, if the bomb explodes on the ground or under water, it builds up such a force that even the apparently safest shelters or strongest ships cannot withstand it.

The Bikini experiments, carried out since the nuclear attacks on Hiroshima and Nagasaki, apparently had even more terrifying consequences but we do not yet have enough precise information on the subject to be able to form a reliable opinion.

*b) Civil defence*

This is what most concerns us, as civilians living in cities, because nuclear war would mean first and foremost the destruction of towns and industrial centres.

Is passive civil defence possible?

If the atom bomb explodes right on the ground, the answer to this question would seem to be no; the force of the blast would be so great that shelters, even protected by several metres of concrete, would cave in as a result. Furthermore, how could these shelters be fitted with a ventilation system which would block the entry of radioactive substances? Even if this was feasible, persons in the shelter would have to be able to remain there for a very long time before emerging, so as not to expose themselves to the radioactivity in the atmosphere.

On the other hand, it seems that underground concrete shelters, with walls five or six metres thick, will withstand the blast of a bomb which explodes several hundred metres above the ground. This was the case in Hiroshima. Moreover, even if the bomb explodes on the ground, some shelters further away from the centre of the explosion will remain intact, as the triple action of the blast, the heat and the radioactivity moves along the surface of the ground and is attenuated by successive obstacles, such as dwellings, offices, etc., which will act as shields to the more distant buildings.

To sum up: despite uncertainty about the efficacy of shelters, they must be retained for civil defence purposes. However, it would be wise to locate hospitals, and stores of food, water and medical supplies outside the cities, if possible behind hills or slightly rising ground.

The treatment of persons affected by ultra-violet radiation is the same as for burn victims, but it must be borne in mind that all have been exposed to a greater or lesser extent to gamma rays. In order to counteract the effects of the latter, as in the treatment of hiroshimitis, small transfusions of whole blood should be given several times a day, as well as plasma, etc. Massive transfusions are contra-indicated as they only increase the purpura and blood suffusions. Penicillin successfully combats secondary infections.

Above all, healthy or injured people should be immediately evacuated from towns having suffered a nuclear attack, to protect them from the effects of long-term radiation.

In conclusion, for someone who was a witness, albeit one month later, of the dramatic consequences of this new weapon, there is no doubt in his mind that the world today is faced with the choice of its continued existence or annihilation.

If this weapon is used in a future war, we shall experience the annihilation of thousands of human beings in appalling suffering.

A parallel can be drawn with the First World War, when poison gas was first used at Ypres. After the war, the various nations, horrified by the effects of this poison, signed a convention banning the use of this gas for ever in future armed conflicts. This commitment was upheld during the Second World War, to the credit of humanity.

Once again, the world is at the edge of an abyss and peace has only just been re-established. Political ideals and material interest seem to be incompatible today and nobody has the right to demand of anyone that he give up these ideals or interests.

The mystical and material forces of the world are at work, for better or for worse. Nobody can foresee the outcome. And these forces are being stirred up by men. It is to them that we should express our anxiety, to them that we should cry out in alarm: Do the same for atomic energy as you did for poison gas. Ban its use in time of war, if the worst happens and war itself cannot be avoided.

Only a unified world policy can save the world from destruction. State leaders should follow the example of doctors and scientists, who come together at congresses to share the benefits of discoveries and new ideas with their colleagues. The world would then have the peace of mind it longs for.

**Dr. Marcel Junod**

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