THE ATOM BOMB AND CIVILIAN DEFENCE FOR THE CAPE PENINSULA*

J. P. DE VILLIERS, *C.B.E., E.D.*, M.D., D.P.H., *Cape Town*

The reason why I am introducing this grim subject to medical men is that, wherever any catastrophe occurs which involves casualties through injury and sickness, there the medical profession will always have to play a major part. To do so effectively we must know what to expect and, furthermore, with that knowledge we should help in developing a plan of campaign to cope with any situation that might arise.

With this in view I propose looking at the problem before us from 4 different angles:

1. The destructive powers of the atom bomb and the hydrogen bomb.

2. The possible dangers to us in South Africa from the use of nuclear weapons in another world war.

3. The necessity of an emergency organization for the Cape Peninsula.

4. The ABC practical approach for such an emergency organization.

THE DESTRUCTIVE POWERS OF THE ATOM BOMB AND THE HYDROGEN BOMB

In the last war the dangers to the civilian population were from high explosive bombing from the air, in the form of detonating bombs of various sizes up to 'blockbusters', time bombs dropped by manned aircraft, the V2 rocket, or the VI pilotless aircraft. The chief dangers were from (1) blast caused by the explosion, (2) flying splinters, (3) falling masonry and flying glass, (4) fires caused by the explosion, or (5) disruption of essential services such as water supplies and water mains, sewage disposal works and mains, and power mains (electricity and gas). The ordinary civilian had a reasonable chance of escaping from these perils. He could find shelter in his slit trench in the open or Anderson shelter at his home, or in some other refuge, and become active immediately after the explosion, if there was no direct hit, to help his family and his neighbour and to rescue those who could be rescued and help extinguish the fires. Even when chemical warfare threatened he could take precautions in order to be active and helpful both to himself and his neighbour (oilskins, masks, protective ointments, etc.).

Then, on 6 August 1945, we were introduced overnight to the atom bomb. In quick succession we had the horrors of Hiroshima (6 August) and Nagasaki (9 August), and from that time onwards we have had to realize that the dangers of high explosive bombing would be multiplied a millionfold, and that there would be two additional horrors to add to the list, viz. (1) heat flash and fire storm, and (2) radio-activity (immediate and delayed). Let us, then, study the nuclear bomb and see what we can expect from this terrible menace.

The atom (or fission) bomb comprises two blocks of uranium-235, which, when brought together by the firing of a charge of explosive within the bomb, explode by nuclear fission. The hydrogen (or fission-fusion) bomb consists of an atom bomb surrounded by a mass of hydrogen isotopes (deuterium and tritium), which when raised to an intense heat by the explosion of the atom bomb explodes by nuclear fusion with the conversion of hydrogen into helium.

Vast as is the explosive power of the atom bomb (the one dropped on Nagasaki was equivalent to 20,000 tons of high explosive), the hydrogen bomb is still mightier, attaining to the power of 10 million tons (10 megatons) of high explosives.

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Now, when a nuclear bomb of either kind explodes, its contents are transformed into a white-hot radio-active ball of gas—the so-called fireball—with a temperature approaching that of the sun's surface. From this fireball a dazzling flash of light, intense heat, and various forms of radio-activity, shoot out in all directions, followed by blast and sound waves. Most of the energy of the bomb is released during the fireball stage.

The fireball grows in a few seconds to its full size and, being much lighter than air, soars upwards at over a hundred miles an hour, quickly losing its brilliance as it cools by expansion and mixing with the surrounding air. In a few minutes it has reached its full height of 60,000 - 100,000 feet and turned into the familiar mushroom-shaped cloud. With a normal ('nominal') atomic bomb the fireball reaches a maximum diameter of about 300 yards. With a 10-megaton hydrogen bomb the maximum diameter may be 3-4 miles.

Now much of the effects of an atom bomb, particularly those resulting from radio-activity, will depend on whether the bomb is exploded high above the surface (say 1,000 feet up, as at Nagasaki) or on the surface of the earth. The reason is as follows:

As it rises, the fireball sucks in particles of dust and droplets of water from the surrounding air. Drawn up into the cloud, these mix with the fission-products of the explosion and become radio-active. The cloud gradually thins out and drifts downward. Its radio-active particles eventually fall to earth but, in the case of an airburst, they are so small and so widely dispersed that by the time they come down—days, months or even years later—almost all their radio-activity has been given off. If, however, the explosion is on or near the ground, the heat and blast effects are slightly reduced but the danger from radio-active particles is much greater. The force of the explosion may result, in the case of a 10-megaton bomb, in a crater about a mile across and up to 200 feet deep, from which hundreds of thousands of tons of earth, stones and other surface material are ejected. All the matter in contact with the fireball becomes highly radio-active. As the fireball rises, it sucks up into the mushroom cloud most of these radio-active materials together with dust and heavier particles, which may become contaminated by contact with the radio-active material from the bomb itself. Some of the heavier particles spill out around the point of explosion but the rest of the radio-active material sucked up with the cloud is carried away by the winds of the upper air and is still dangerously radio-active when it drifts back to earth. This is known as the fall-out.

The enormous energy released from the explosion of an atom bomb takes 3 main forms capable of causing damage to materials and injury to persons, viz. (1) heat flash, (2) blast, and (3) radio-activity.

1. *Heat Flash* (*Thermal Radiation*)

The fireball of a nuclear explosion gives out an immense quantity of heat. With an atom bomb similar to the one used at Nagasaki, the heat flash lasts only 1½ seconds and most of it is over in ½ second. With the hydrogen bomb heat is radiated for a longer period, mostly in the first 10 seconds. The heat rays from the fireball travel with the speed of light and heat up surfaces into which they are absorbed.

People directly exposed to the heat flash from an airburst 'nominal' atom bomb within a mile of the explosion, and escaping immediate death, would receive severe third-degree burns; up to about 1½ or 2 miles second-degree burns (blisters); and up to about 2½ miles first-degree burns (reddening). The clothing, though it may catch fire (when it must be quickly removed or the flames extinguished) affords some degree of protection at ranges over ½ mile. The risk of ignition is reduced if the outer garments are of wool rather than cotton and if they are of light colour rather than dark.

The importance of covering as much of the skin as possible is obvious from the fact that the risk of death from burns depends on the proportion of the area of body burnt.

As the heat rays travel in straight lines 'it is relatively easy to gain protection, since one only has to be out of the direct path of the rays from the fireball. Complete protection from heat-burn could be achieved if everybody took cover; any form of building, shield or covered trench would suffice'.

Primary and secondary fires. 'Primary fires' would be started by the heat flash from an atom bomb in buildings in a zone mainly restricted to a radius of about 1¼ miles. 'Secondary fires' might result from the short-circuiting of electric wires, the breaking of gas mains, and the collapse of buildings onto domestic fires.

2. *Blast*

As would be expected, the blast from the atomic or hydrogen bomb extends much farther than that of the high explosive bomb. It travels at the rate of sound (1,100 feet per second, 12 miles per minute).

An atomic bomb of the type dropped at Nagasaki, if exploded at a height of 1,000 feet above ground, would level all buildings within a radius of ½ mile, and buildings within a radius of between ½ and ¾ mile would be damaged beyond repair. Beyond that, those within a radius up to 2 miles would suffer severe damage, and light damage would extend as far from the centre as 3 miles.

With a 10-megaton hydrogen bomb the damage would extend over a radius 7 or 8 times as great. Such a bomb bursting at ground level is expected to produce a saucer-shaped crater about a mile wide and up to 200 feet deep, and the debris from the crater to be scattered in a ring about 2 miles across. Buildings would suffer destruction up to a radius of 3½ miles, irreparable damage up to 5 miles, severe to moderate damage up to 13 miles, and light damage up to 20 miles.

The danger to people would lie mainly in the fact that they might be struck by falling masonry, by flying debris or by fragments of glass and tiles, or that they might themselves be thrown against some object. As with the heat wave, any effective cover, or protection from the direct blast, affords a measure of safety; e.g. a slit trench in the open or a cellar or basement.

3. *Radio-activity*

The danger from radio-activity is divided into (*a*) immediate danger (lasting for only a matter of seconds) and (*b*) delayed danger.

The fireball in a nuclear bomb explosion is intensely radio-active, emitting ionizing radiations which consist of *alpha rays, beta rays, gamma rays* and *neutrons*. The alpha and beta rays can for practical purposes be disregarded as relatively unimportant; they are for the most part absorbed in the fireball and have little penetrating power. The beta rays may play a small part in the contamination of the ground, but this is of secondary importance.

The chief source of *immediate danger* are the gamma rays. These are similar in their general nature to X-rays, although they are usually shorter in wavelength and more penetrating. They travel at the speed of light (186,000 miles per second). They are scattered by atoms of oxygen and nitrogen in the air and at each encounter their direction is changed, charged ions are produced, and some of the energy is lost. They are also reflected from near-by objects in the same way as light rays. The effect is that during the period of about a minute while the fireball is emitting gamma rays (chiefly in the first few seconds) most of the gamma radiation comes in the direct beam from the fireball, but an appreciable proportion comes from every other part of the sky, just as in strong sunlight a room with no window on the sunny side still receives light from the visible sky and from reflection from other objects.

The intensity of the gamma radiation decreases as the square of the distance, and is further reduced in the course of the encounters with the atoms of the air. Judging from experience of high airburst bombs in Japan, the effective danger range from radio-activity appeared to be 1¼ - 1½ miles from the centre of the damage. It is estimated that from an airburst explosion of a 'nominal' atom bomb the mortality from gamma radiation of unprotected persons within a radius of ½ mile from the centre would be nearly 100%, and within a radius of ½ - ¾ mile 50%. Beyond 1½ miles there should be no danger. With a 10-megaton bomb, on account of scattering, the distance for a 50% lethal dose is increased to only 2½ miles, and there is no significant risk beyond 4 miles.

The gamma rays have great powers of penetration and will pass through considerable thicknesses of building and other materials. Clothing affords no protection.

The results of radiation sickness manifest themselves in one or more of the following symptoms: Loss of hair, loss of appetite, sore throat, pallor, blood spots under the skin, vomiting, diarrhoea, nose bleeding, fever, and emaciation. Persons affected feel nothing at the time. Symptoms do not show themselves until later—how soon depending on the strength of the dose.

The danger from radio-activity is all the greater because it cannot be seen, smelt, heard, felt or tasted. It can be detected and measured only by instruments, of which there are 3 specially designed for use in Civil Defence, viz. (*a*) the individual dosimeter, (*b*) the Radiac survey meter, and (*c*) the contamination meter.

Delayed danger from residual radio-activity may result from (*a*) radio-active fission products contaminating the fall-out or the area surrounding the crater, and (*b*) radio-activity induced in materials penetrated by the neutrons emitted by the fireball. Such residual radio-activity operates by the penetrating 'gamma' rays given off and from actual radio-active particles getting onto the body or being breathed or swallowed.

The radiation dose rates in the area involved in residual radiation are likely to be small compared with those from the initial gamma radiation in the devastated area. Nevertheless, because the contaminated material stays on the ground, the exposure to the residual radiation may be a continuing one and therefore may cause serious or even lethal effects.

It will be obvious what sort of protection will have to be looked for here—the basement room or cellar, heavily protected and stored with food and water (uncontaminated) and always assuming that one is still alive after the effects of heat flash and blast. This hope of survival is based on the fact that all radio-active material gives out less radiation as time passes. This is known as the 'decay' of radio-activity. The rate of 'decay' follows known laws and cannot be speeded up or slowed down. After 2 days the fall-out dust would be a hundred times less dangerous than it was at first but, even then, it might still be dangerously radio-active.

POSSIBLE DANGERS IN SOUTH AFRICA IN ANOTHER WORLD WAR

There are cogent reasons why we in South Africa should earnestly think about Civil Defence in the event of a future war:

1. Another world war is likely to involve the Union of South Africa.

2. South Africa is now within striking distance by air and by sea of its potential enemies. Thus an atomic bomb can be deliberately exploded upon strategic targets in South Africa, or nuclear weapons can be used on coastal targets by submarines, or space projectiles can be directed onto targets in our country from suitable bases under enemy control.

3. Civil Defence, therefore, is for South Africa more important and vital than ever before and we cannot start too early to plan and prepare against the possible calamity of a future war, with its nuclear weapons.

In the next world war the main battlefields will be in the Northern Hemisphere. At present elaborate and costly Civil Defence preparations are being undertaken in America and Great Britain, where they are thinking in terms of (*a*) large-scale evacuations of sections of the population of certain large cities; (*b*) the provision of shelters for protection against heat, blast and radio-activity; (*c*) the rescue and treatment of casualties. All these preparations involve the governments concerned in the expenditure of millions of pounds sterling and thousands of millions of dollars.

In the Cape Peninsula we must be prepared to face the following situation: Whether an atom bomb explodes over Cape Town or whether there is a submarine raid on Cape Town's docks and harbour area designed to put it out of action, both of these forms of destruction will have this in common, that there will be fires to be extinguished and controlled; casualties to be rescued and treated; survivors, other than casualties, to be evacuated, housed and fed; and dead to be buried. Damage may also be suffered by essential services, such as water supply, sewage disposal and power mains, which will want safeguarding or restoration.

The main differences between these two contingencies would be in the immensity of the destruction and the added hazard of radio-activity in the case of the atom bomb.

What may happen to Cape Town and the Cape Peninsula could happen to Durban and other ports round our coast and to inland centres if they are thought worth-while targets by the enemy.

NECESSITY OF AN EMERGENCY ORGANIZATION FOR THE CAPE PENINSULA

The Union Government has accepted Civil Defence as a national issue. The Department of Justice has been made responsible for planning Civil Defence, and Major-General J. A. Brink was appointed Director of Civil Defence some 2 years ago. A comprehensive prototype plan has been drawn up for the Union of South Africa and South West Africa, which will pivot on local authorities. Most of the larger local authorities have been notified of this plan in a confidential document and all the local authorities in the Cape Peninsula have agreed, in principle, to cooperate to the best of their ability.

Many of us are getting anxious and we want to see a basic plan come into existence right now in the Cape Peninsula, so that if a sudden large-scale disaster overtakes the Peninsula at some future date we shall have established an emergency organization for self preservation and restoration of order immediately after the catastrophe. For, as I see the position, in the event of another world war the Peninsula must be prepared in the first instance, not so much against continued periodic attacks or an invasion, but rather against a sudden, large-scale disaster. The Cape Peninsula may well become a direct target for the destruction of Cape Town harbour or Simonstown harbour, or both, in order to hamper the Western powers on their important line of communication by sea around our coast.

THE ABC PRACTICAL APPROACH FOR AN AMERGENCY ORGANIZATION

In the planning of an emergency organization for the Peninsula to deal with a large-scale disaster such as we are visualizing, it is essential to take into consideration 3 main aspects of the problem, viz. (1) the factors common to all large-scale destruction of inhabited areas, (2) the resources available in the area to cope with the results of the destruction, and (3) the acceptance of a plan which will permit the effective mobilization of the resources available and, if necessary, augmented form elsewhere:

1. *The factors common* to all disasters due to large-scale destruction can be summarized as follows:

(*a*) Destruction of buildings with falling masonry and flying glass.
(*b*) Fires, which will be started in a dozen different ways.
(*c*) Casualties as the result of the destruction.
(*d*) The homeless—evacuated either before or as the result of the destruction of homes.
(*e*) Bodies to be buried.
(*f*) Damage to essential services (water supplies, sewerage sytems, and power mains).

2. *The resources available* include the following:

(*a*) The 10 local authorities, viz. the municipalities of Cape Town, Simonstown, Goodwood, Parow, Bellville, Durbanville, Fish Hoek, Pinelands and Milnerton and the Cape Divisional Council.
(*b*) The hospital services of the Cape Provincial Administration.
(*c*) The auxiliary services, viz. the Red Cross Society, the St. John's Ambulance Association, and the Noodhulpliga.
(*d*) The medical profession.
(*e*) The nursing profession.

3. *The basic plan.* The obvious practical approach to the combating of a disaster in the Cape Peninsula is in the direction of utilizing all the resources available in the area. With this in view these resources listed under (2) should be divided into 2 main groups, viz:

A. The 10 local authorities, who would be expected to pool their resources and produce a coordinated plan for fire-fighting and rescue work, evacuation of survivors and homeless, burials, dealing with destroyed and damaged buildings, clearance of highways, control of transport facilities, safeguarding and restoration of essential services (water, sewerage and power), maintenance of law and order, and prevention of looting.

B. The hospital services of the Cape Provincial Administration, the auxiliary services (Red Cross Society, St. John's Ambulance Association, and Noodhulpliga), the medical practitioners, and the nursing profession outside the hospital services. These bodies should pool their resources and produce a coordinated plan to provide:

(*a*) Reception places for the treatment and nursing of casualties either at existing hospitals or emergency hospitals planned for this purpose.
(*b*) The formation of rescue teams with medical, nursing and auxiliary personnel trained and ready for immediate mobilization when required.
(*c*) Reception areas for the homeless and all that this will entail.

These two planning bodies should then coordinate their plans into the one main plan of the Cape Peninsula Emergency Organization.

To start this basic planning I would suggest that the Cape Town Municipality take the initiative on behalf of Group A (local authorities) and that the Director of Hospital Services take the lead on behalf of Group B.

CONCLUSION

The reasons why in my opinion it is essential for the Cape Peninsula to initiate a basic plan on the lines mentioned above may be summarized as follows:

(*a*) We shall be mustering our resources available in the Cape Peninsula without spending large sums of money.

(*b*) We shall get to know what part those who are willing can play in the common cause of self-preservation.

(*c*) We shall be starting to discipline ourselves and perhaps minimize the inevitable panic that is bound to prevail in the absence of planning.

(*d*) We shall be setting an example to other neighbouring local authorities such as Stellenbosch, Paarl, Malmesbury, Somerset West, Strand, Worcester, Moorreesburg, Piketberg, etc. who may be led to make similar basic preparations to help themselves and possibly their neighbours in case of need.

(*e*) When we can report progress in such basic and fundamental preparations requiring team-work, then it will be easier to think and plan in terms of radio-activity lest we should be faced by that eventuality.

(*f*) Furthermore what is envisaged up to this point cannot fail to be fundamental to any national plan of the Central Government.

(*g*) Above all we shall be making a start which is long overdue.

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