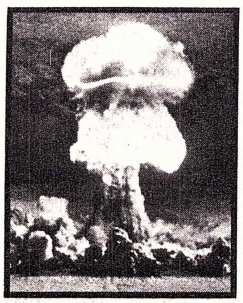
NUCLEAR WA

ITS EFFECTS
HEALTH AND
HEALTH SER



The introduction of nuclear weapons has added entirely new dimensions to warfare. Quantitatively it has brought an enormous increase in explosive power over that of conventional weapons. Whereas atom bombs of the type used in Hiroshima and Nagasaki represented an increase from tons of TNT to the equivalent weight of thousands of tons (kilotons), hydrogen bombs, developed about a decade later, represented an increase from kilotons to millions of tons (megatons). During the last two decades nuclear weapons have been amassed to an estimated total of nearly 20,000 megatons. Such is the increase in destructive potential that a single thermonuclear bomb can have an explosive power greater than that of all the explosives used in all wars since gunpowder was invented. The explosive power of the nuclear arsenals of the world is now about 5000 times greater than that of all the explosives used in the Second World War.

The weight of nuclear material needed to produce a 20 megaton bomb is less than 10 tons. With present-day technology nuclear bombs can be projected to any place in the world. To produce the same blast effect with dynamite would require material weighing more than the Great Pyramid of Egypt.

The qualitative difference between nuclear and conventional weapons is of even greater significance than the quantitative difference. The two most lethal agents in conventional weapons are blast and heat. Both cause death and injury when nuclear weapons are used, but to an extent thousands of times greater. Nuclear weapons, however, also produce new lethal effects by radiation. Furthermore, the radioactive fallout can affect people at great distances from the explosion. The radiation from the fallout can have lethal effects long after the explosion and is also an obstacle to rescue operations and to effective medical care of the injured. And its deleterious effects may continue to be felt in future generations, long after hostilities have ended. Less quantifiable effects of nuclear war include atmospheric changes detri-

Charred remains of a y Nagasaki, August 1945.

Photo WHO/UN/Y. Yamahata

Inset: L. Sirman ©

mental to agriculture and th in all parts of the earth.

The detonation of nuclea gives rise to the following:

blast wave; thermal wa radiation (neutrons anc rays); local radioactiv global radioactive fallou magnetic pulse; atmosp turbances.

Some of these phenome known only as a result of testing of bombs and are fully understood. They prod cal or biological effects or bc all of which are directly c to human health. Some ar damage the environment.

The extent of damage ca nuclear bomb obviously de only on the type and size of but also on the height at detonated, the atmospheric the time of the detonation, bomb of given size there is

by Sune Bergström

Professor Bergström was the Chairman of an International Committee of Experts in Medical Sciences and Public Health who were invited "to study the contribution that WHO could and should make to facilitate the implementation of the UN resolutions on strengthening peace, détente and disarmament and preventing thermonuclear conflict." In May, the report of that Committee was put before the 36th World Health Assembly, held in Geneva. The present article by Professor Bergström—who received a Nobel Prize last year for his work on prostaglandins—is a shortened version of the report, which is to be published in the near future by WHO

: at which the area affected by a wave of given strength would be t and the number of deaths and s from blast greater than for any height.

height of the detonation is the factor determining whether there be local radioactive fallout or the fireball, whose size would d on the explosive yield of the , touched the ground it would up huge quantities of earth and together with the radioactive cts of the bomb. These would be carried away by the wind ner with the mushroom cloud. the fireball cooled, the radioy would condense on the particles material sucked up, many of which be large and descend by force of y, the heaviest first. This deposif radioactive particles constitutes cal fallout. If the explosion was at a height that the fireball did not the ground, there would be no fallout unless the mushroom encountered a rain cloud, in case some radioactive particles come down with the rain.

relation to the amount of blast ge and number of possible casualties, nuclear weapons—at the lower end of their explosive power—overlap with such conventional weapons as the blockbusters of the Second World War, which contained about ten tons of TNT. There is no upper limit to the explosive power of nuclear weapons.

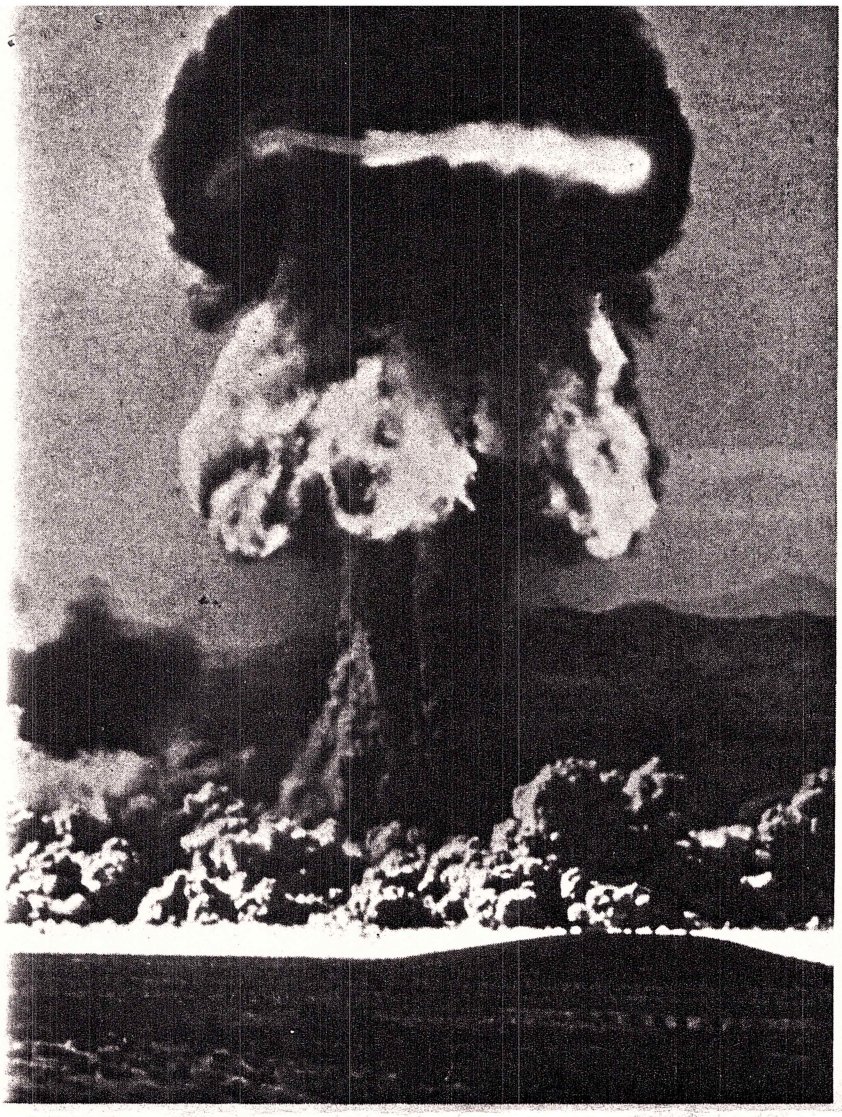
The electromagnetic pulse would present no direct hazard to human beings, but it would disrupt communications and thus place enormous difficulties in the way of rescue efforts.

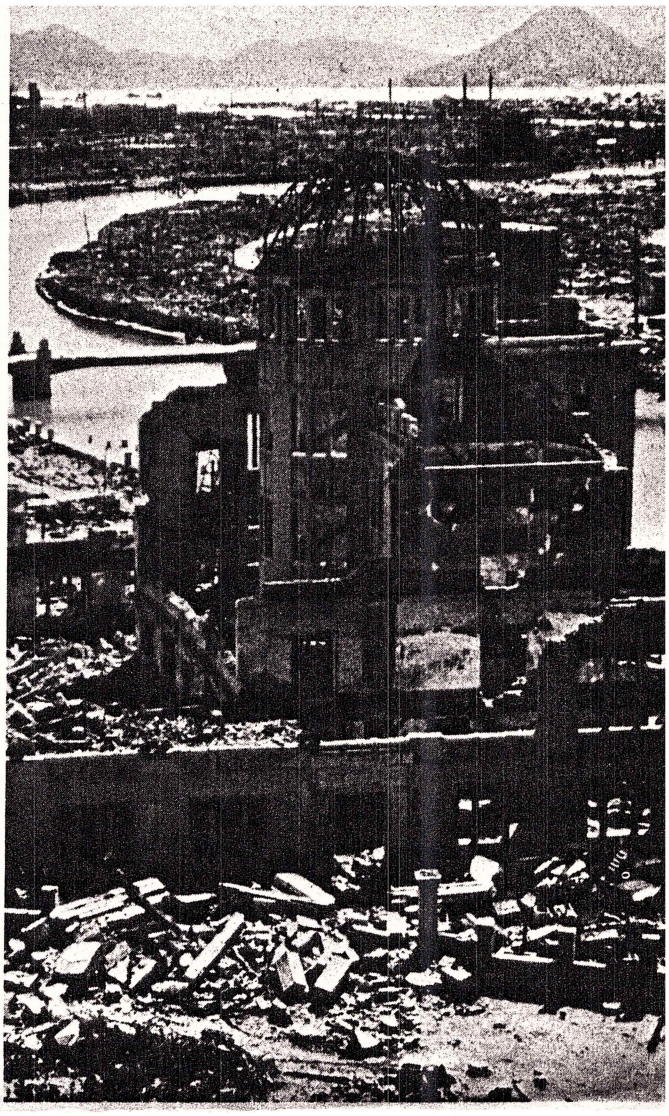
Almost half of the total energy released in nuclear explosions is in the form of a blast wave, the colossal build-up of pressure in the vaporised material of the bomb giving rise to a wave travelling through the air at supersonic sped. As the blast wave spreads, its intensity gradually diminishes until it is effectively dissipated, at distances that, if the bomb is in the megaton range, may be tens of kilometres or more.

The human body can be crushed by the blast wave up to distances where the overpressure is one atmosphere i.e. the total pressure is double the atmospheric pressure. If people at a short distance from where the explosion took place were shielded from the thermal wave and the initial ionizing radiation, they would die mainly from direct blast damage, particularly to the lungs.

The heat flash contains a third of the total energy released by a nuclear bomb. It results from the extremely high temperature generated at the moment of the explosion and is of short duration, about a second for low-yield bombs and about ten seconds for bombs in the megaton range. The thermal wave starts practically instantaneously, well ahead of the blast wave, and travels at the speed of light. The effect of the high temperature is to vaporise everything within a certain distance (in Hiroshima nothing remained of some people but outlines on stone benches), melt solid materials at greater distances, and still further away start fires.

An effect that could have catastrophic results would be the fire storm, of the kind that raged in Hiroshima and ravaged Dresden and Tokyo after the aerial bombardment during the Second World War. Within the area of the fire storm the temperature can rise to such heights that people even in





heavily protected shelters could be cremated or die from lack of oxygen.

A small proportion, about five per cent, of the energy released by the explosion of most nuclear weapons appears in the form of neutrons and gamma rays emitted in the first minute. An exception is the enhanced radiation warhead commonly known as the neutron bomb; the proportion of the energy carried by the neutrons in such a bomb could in theory be as high as 80 per cent.

The initial radiation would not contribute much to the overall casualty toll from bombs larger than 100 kilotons, as the lethal area from blast and heat is then larger than that from radiation. With smaller bombs, and especially with neutron bombs, the lethal area from neutrons and gamma rays would much exceed that from blast and heat.

Under the conditions in which local fallout occurs, that is, when the fireball touches the ground, and depending on the size of the bomb, its radioactive products would be deposited over large areas downwind and expose people within certain areas to lethal doses of radiation. For example, after a surface burst of a one-megaton bomb people remaining in the open for a long time could receive lethal doses of radiation within an area of nearly 2000 square kilometres.

Since the natural decay of the radioactivity in the fallout is initially very rapid, the critical period for exposure is the first few weeks. Staying indoors or in specially designed shelters could to a considerable degree reduce the radiation dose received. A good shelter could reduce the dose by a factor of 1000 or more. The protection afforded by an ordinary house would depend on its structure and other characteristics.

Much larger numbers of people would be exposed to global fallout, which results from the injection of radioactive particles into the upper atmosphere and their subsequent descent weeks or months later all over the globe. By that time only the long-lived isotopes, particularly strontium-90 and caesium-137, would be significant. The doses from global fallout are very much smaller than from local fallout and no acute effects would occur, but the long-term effects, extending over many years after the explosion, would include cancer and genetic defects.

Left: *A ten-megaton blast eru sinister mushroom cloud abov in the Pacific Ocean.*

Above: *Amid a wasteland of homes rises the gaunt Hiroshima's Prefectural Indust tion Building, preserved since monument and a warning: ne*

Photos L. Sirman © and WHO/UN/E. Matsumo

Exposure of people to the fallout radiation can occur whole-body external ir through external irradiation the body, or through interna tion by radioactive elements been inhaled or ingested.

The most important effects body irradiation are the acute syndromes, commonly ref as radiation sickness. The s these syndromes depends on ation dose received. In the let of doses three degrees of se be recognised: (1) the centra system syndrome, characteri ternating states of stupor and citability, with unavoidable de in a few days (this is the effect by the use of neutron bombs

tinal syndrome, character-
usea, persistent vomiting,
orrhagic diarrhoea, with
ring within a week or two;
e haemopoietic syndrome,
ed by nausea, vomiting,
anaemia, and immunity
es.

ualties

prediction about the casualties in a nuclear war made with any claim to But estimations show that ion of a one-megaton bomb e city would kill more than half million people and nany. A "limited" nuclear smaller tactical nuclear totalling 20 megatons and ilitary targets in a relatively pulated area, would exact a ut nine million dead and njured, of whom more than n would be civilians. And an ear war using at least half of ited present stockpiles of apons (an approximate total megatons) might result in 1000 million deaths and n injured people.

humb procedures have loped for dealing with the conventional warfare and asters, but it is difficult to ey could be applied in situa- e the number of casualties into millions, hospitals and centres would be mostly rubble, fires rage, survivors ricken or, as in Hiroshima, a state of stupor, and help, at all, be prevented from e people who needed it by esence of radiation.

ch conditions, with facilities es reduced, the capacity of g medical personnel to pro- ate treatment for casualties rely to provide first aid and ctims alive, would be next to er, entering the fallout area sent considerable hazards. ms would have to be moni- f possible, decontaminated, nnel would have to be prevent them from being o too much radiation. In the disorganization such mea- ld probably be impossible. portion of health personnel ld probably continue to be an that of the general because of their exposure , disease and other hazards.

It is obvious that no health service in any area of the world could cope adequately with the hundreds of thousands of people seriously injured by blast, heat or radiation from even a single one-megaton bomb. Even the death and disability that could result from an accidental explosion of one bomb from among the enormous stockpiles of weapons could overwhelm national medical resources.

"As doctors and scientists, the members of the Committee feel that they have both the right and the duty to draw attention in the strongest possible terms to the catastrophic results that would follow from any use of nuclear weapons. The immediate and the delayed loss of human and animal life would be enormous, and the effect on the fabric of societies would be either to impede its recovery or make recovery impossible. The plight of survivors would be physically and psychologically appalling. The partial or complete disruption of the health services would deprive survivors of effective help.

The Committee is convinced that there is a sound professional basis for its conclusions that nuclear weapons constitute the greatest immediate threat to the health and welfare of mankind. It is not for the Committee to outline the political steps by which the threat can be removed; but mankind cannot be secure until that is done."

Short-term effects

In the first few days and weeks after a nuclear attack a great many health problems would appear, not only for the injured but also for the uninjured survivors, as a consequence of the collapse of the existing framework of society, the lack of food, the disruption of the health services, and the damage inflicted on the environment. These problems would be aggravated by the dislocation of the administrative structure, the destruction of sources of energy, the breakdown of communications and, possibly, social disturbances. Since the supply of water would undoubtedly be interrupted, water would be of crucial importance. Rain could concentrate the fallout in some localities, producing high levels of radioactive contamination, and fresh water would be contaminated above safe levels for drinking. Fresh food would also be contaminated with radioactivity, the only safe food being canned or food stored so as to prevent contamination.

Long-term effects

The long-term effects of a nuclear war are more difficult to predict but may be just as devastating to human health as the short-term effects. Among them are the effects on the social and economic structure—the destruction of industry and agriculture, the uprooting of people, social disorder, and secondary warfare; on water supplies; on sanitation and public health; on the incidence of cancer and genetic effects; and on the climate and the environment.

With the destruction of public health and sanitary facilities the way would be open for the spread of disease. Water supplies would be contaminated not only by radioactivity but also by pathogenic bacteria and viruses, sewage treatment and waste disposal facilities would have disappeared, and lack of refrigeration would have led to spoilage of food supplies. The survivors emerging from shelters would not find conditions outside much better than those inside. Millions of putrefying human and animal corpses and mounds of untreated waste and sewage would provide a perfect breeding ground for flies and other insects that are more resistant to radiation than man. The uncontrolled growth of insect populations would favour an increase in the numbers of insect vectors of disease. Contaminated water and food would spread the enteric diseases.

Adequate food for the survivors would be an acute problem. Fertile agricultural lands would have been laid waste by fire and residual radioactivity. Erosion by wind and weather would lead to desertification of some areas of at present arable land, rendering it unfit for agriculture or even animal husbandry. Many millions of survivors from the immediate attack would die of starvation and malnutrition during the ensuing few years. It is a tragic irony that, whereas the warning time and action and reaction in nuclear warfare have shrunk to hours and minutes, the detriment to health it could cause would continue for years, decades, and generations. ■