# THE A-BOMB'S INVISIBLE OFFSPRING

BY EDWARD P. MORGAN

THERE have been a lot of guesses, some sober, some wild, about what is going to happen to this planet if nations start breaking one another's skulls again. How perilous is living in the Atomic Age going to be? Here, two years after Hiroshima, one after Operation Crossroads, are some of the salient facts, the guarded conclusions, the troubled theories of military men, doctors and scientists—the people who know the atom best:

1. Radioactivity equivalent to the energy emitted by more than 1,000 tons of radium was released in Test Baker at Bikini, the first underwater explosion of the atomic bomb.

2. More than a year afterward, some 50 of the 65 ships in the target array are still so contaminated with radioactivity that under accepted safety standards they cannot be manned.

3. No way has been found to decontaminate a ship or any other object polluted with radioactivity.

4. Bikini Atoll and lagoon still have "warm spots" of radiation and are classed as unsafe for habitation.

5. Fish and algae retrieved after Test Baker had soaked up so much radioactivity they could take their own X-ray pictures.

6. All the pigs and 75 per cent of the rats in Test Baker perished.

7. Radiation has changed the shape and color of some plant life.

8. Changes in the color of human skin, and formation of massive, ugly scar tissue called keloids, some of which didn't stop growing until nearly a year after the bombings, were numerously noted on burned survivors at Hiroshima and Nagasaki.

9. Intensive radiation may spread cancer.

10. Temporary sterility was caused in many survivors, male and female, in Japan.

11. Some scientists fear that strong radiation might dangerously alter human cell structure and ultimately produce freaks.

12. Radioactive particles from the five bombs that were exploded are still floating around—harmlessly—in the upper air. But scientists are seriously debating what is the *X* number of bombs (500? 10,000? a million?) it would take to overload the stratosphere and threaten the habitable areas of the globe.

13. Whatever *X* may be, no real defense against atomic warfare is even in sight.

Scare you? The radiation Test Baker released was a billion times as potent as a gram of radium. Much of it quickly "died" as fission products from the blast decayed into stabler substances but a powerful amount of it still exists. In 1940 there were ap-

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**This rat received flash burns on his ears during the first Bikini test. He may also have "burns" which wouldn't show. This rat was much more severely burned in the overwater atomic explosion at Bikini. Test animals are pampered in Navy's magnificent hospital in Maryland.**

proximately 1,000 grams (about two pounds) of known separated radium in the world. One microgram (a millionth of a gram) of it could, under certain circumstances, kill a person.

Some of the Bikini ships are still so "hot" that men can't work aboard them for more than an hour or so at a time, even with masks, special clothing and shielding devices. (The radioactivity of a substance is comm nly measured in terms of a roentgen an the maxim m safety level is 1/10 of a roentgen a day. This is generally more radiation than is emitted by luminous dials on the instrument panel of an ordinary transport plane.)

Several of these ships were washed, scrubbed and hosed with fresh water, sea water and chemicals. Their decks were scoured and scraped; their paint chipped. Applying fresh paint---which contains lead, which is a shield against radioactivity—didn't work. Cleansing experiments continue. So far, nothing has had any material effect. Two weeks after the explosion the washed vessels registered relatively the same radioactivity as the unwashed. Radioactivity is indestructible and cannot be neutralized. The only answer is to let it peter out of its own accord.

## Duration of a "Half Life"

This may be a long process: Radio sodium, produced in enormous abundance when the Baker blast acted on sea salt, loses half its potency in 14.8 hours. Scientists call this a "half life." Radio phosphorus has a half life of two weeks; radium 1,600 years; plutonium *24,000* years.

These ships are valuable as atomic laboratories but. although they are 300 to 400 times less radioactive today than they were on July 25, 1946, as far as normal naval uses are concerned. they might as well have been sunk. They couldn't even be safely scrapped; the radioactivity might emerge later in somebody's rebuilt yacht, a steel rail or a skyscraper's girder!

The clouds of radioactive rain which soaked the ships missed Bikini Atoll proper, and practically none of the intensely "hot" particles were deposited on dry land, but the water, marine plants, coral reefs. even the bottom of the lagoon, were made radioactive.

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This goat, like all other Bikini survivors, is being bled to see whether it has developed anemia. Radiation kills white corpuscles in the blood of both animals and men.

The secret of the self-photographing fish is simply that when they were placed on X-ray plates, their bones gave out enough radiation to expose the films. It probably would have been fatal to eat the fish then, and Professor Lauren R. Donaldson, University of Washington School of Fisheries radiobiologist who witnessed Crossroads, "guesses" it "would be unwise to eat fish or other marine products from inside the atoll," even now.

No lush forests of vegetation have sprung up in Hiroshima and Nagasaki but a few curiously formed weeds and a variety of plants with albino-spotted leaves have been found around the explosion centers. In Nagasaki after the attack, an agriculturist named Dr. Takeo Furuno planted two vegetable gardens from seeds brought from outside. One plot was 150 meters from the explosion ground center, the other 500 meters. He got some abnormal looking plants from both plots and he got far more from the one nearer the center but the changes are not considered representative.

Destruction of the pigment by intense ultraviolet light from the bomb flash apparently explained some of the color changes in the skin of survivors in Japan. Thick and elevated above the skin, the keloids, as the scar tissue is called, were pink, brown or white. Some were firm to the touch, some sensitive. Some felt warmer than the surrounding skin. The Atomic Bomb Casualty Commission observed that these scar formations may present unique problems in surgical treatment and noted that in some rare cases the possibility of cancer might have to be considered.

Lab experiments, some long predating the Atomic Age, indicate that radiation induces cancer; studies of definite effects on humans are inconclusive. Two struins of mice, one predisposed to have cancer, the other to

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**Keloids, heavy scar tissue, cover the healed wounds of a Nagasaki boy, burned as he leaned on a shovel 1½ miles from the blast**

resist it, underwent Test Able, the overwater explosion at Bikini. None has shown any unusual effects so far. (In Able, ships were exposed to infinitely less radiation than in Baker.)

The sterility in survivors in Japan was blamed on radiation; the sex organs are among the most sensitive to it. A large number of women exposed to direct radiation from the blasts showed definite menstrual disturbances. Several authorities, including Captain R. Harold Draeger, who headed the naval medical-research section at Bikini, believe however that a radiation dose strong enough to cause permanent sterility would also kill a person.

No "monsters" have been detected in the offspring of Japanese survivors and no specific genetic changes observed, but it might take several generations for irregularities to show. Animals and plants already have been made to produce malformed offspring by exposure of their sexual cells to radioactive energy. Fruit flies pelted with X rays, for instance, have produced radically deformed descendants.

After similar exposure of their ancestors, rats have been born with claws on the ends of their noses.

Many bomb victims lost their hair. It's coming in again, in coarser strands, some of it gray and curly instead of straight and black. Beta rays in dust particles fell on the backs of some Hereford cows grazing at Alamogordo, New Mexico, after the first atomic-bomb explosion and turned patches of their hair white. Their regular red hair is returning and no abnormalities have been noted in the cows or the calves they've had since.

Pigs are supposed to have about the

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same resistance to radiation as man: rats have more. Six pigs of a total of 20 succumbed in Test Baker before the ships had cooled enough to be boarded. The other 14 died within 14 days. Of the 199 rats placed on four ships, 70 were dead when recovered; 80 more died later. Virtually all the fatalities were attributed to radiation; the blast broke the water bottles of a few rats and they died of thirst. All the animals used were shielded from the blast by at least one deck or bulkhead. Rear Admiral William Sterling Parsons, Navy atomic-defense chief, said later the area within a half-mile radius of the explosion center would be considered an "intolerable zone" for both men and ships.

Dr. Paul S. Henshaw, until recently radiobiologist at Oak Ridge and now scientific consultant to General MacArthur, is particularly worried about the possibility of an atomic war spreading cancer and also upsetting the normal heredity progression of human cells. "Animals receiving heavy acute exposure of high energy radiation (X rays, gamma rays, beta rays, neutrons) died prematurely, usually in a condition of advanced age, emaciation or some form of cancer," Dr. Henshaw said. "We know that early X-ray workers who received burns on their hands later developed cancer, and that physicians and dentists who have had their hands in X-ray beams too frequently have developed skin lesions which later turned to cancer."

When it comes to genes, the molecules in human cells which determine hereditary characteristics, including sex, Dr. Henshaw said there seems to be no level below which effects are positively harmless. "When the bullet-like particles of radiation act on a cell the intricate organization is disrupted, and if the cell is able to sustain life, some of the modifications may bring about a change that may be passed through succeeding generations. What the frequency for these (changes) is for any dose level is not yet known for human beings."

The Atomic Bomb Casualty Commission report, which Dr. Henshaw coauthored with Dr. Austin M. Brues, observed regarding survivors in Japan that: "from previous irradiation experiences with both animals and human beings, there is good reason to believe that reproductive disturbances, malignancies of one form or another, shortened life-span, altered genetic pattern, etc., will in time appear in greater or lesser degrees."

*But in the whole history of the Manhattan Project there were only two deaths from radiation and in Operation Crossroads there weren't even any atomic injuries.*

Out at Brookhaven, in the middle of Long Island, 75 miles east of New York, the U. S. government is building one of its biggest atomic-research laboratories. Experts consider it a safer place to work than an airplane factory. Satisfied with safety measures, underwriters asked for no extra

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premiums on employees' group insurance policies.

But many atomic experts agree that, theoretically, the whole green areas of the earth would be threatened by radioactivity from the explosion of an *X* number of bombs, and man might be driven to live on the icecaps over the North and South Poles, the only places on earth that the wind currents would keep relatively free of contamination. But they disagree sharply over that unknown *X*. A few argue that if 500 bombs were set off in a short time we would be stepping on danger's doorstep; others say it would take from 10,000 to a million.

Many military men, however, stoutly maintain it's fairy-tale stuff to figure that radioactivity would be used in such strength as to threaten a hemisphere, a continent or even a strategic city for any length of time, on two grounds: First, it isn't easy to deliver an atomic bomb--guided missiles of supersonic speeds have a restricted range, and a certain number of other carriers, like bombers, submarines, etc., would be destroyed before their bombs could be exploded —and second, even if an enemy could make a successful "saturation" attack with radioactivity, he wouldn't want to, because it would render the target area as useless for the victor as for the vanquished.

Scientists would like to believe this, but they see modern warfare following no rules; atomic weapons would blast the conflict quickly out of control.

"One bomb fired in anger would be the beginning of the end," one physicist said.

Dr. Edward Teller, Hungarian-born professor at the University of Chicago, a Manhattan Project scientist and one of the world's leading physicists, calculated that if the activity liberated at Bikini were multiplied by, say, 100,000 bombs or a million and released off our Pacific Coast, the whole of the U.S.A. would be endangered. He admits that it has by no means been proved that such enormous amounts of energy could be so released. But, he wrote in the Bulletin of Atomic Scientists, ". . . . it is much more than a fantastic possibility. If such great quantities of activity should become available, an enemy could make life hard or even impossible for us without delivering a single bomb into our territory.

". . . It is not even impossible to imagine that the effects of an atomic war fought with greatly perfected weapons will endanger the survival of man."

Generally endorsing that warning, several other members of the Federation of American Scientists go further to estimate that if 10,000 atomic bombs were dropped in a six months' war, danger of universal, if delayed, destruction would be real. From 100,000 to a million bombs would almost surely make life, as we know it, wither and die, they say.

A few scientists hold that explosion of only 500 bombs could start a kind of chain reaction of contamination that might threaten all the earth's green belt. Dr. Stafford L. Warren, medical director and chief radiologist of Manhattan District and Bikini, inclines to this theory.

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## A Theory and Its Supporting Facts

The argument is that every time a bomb fell, "hot" areas would be built up and spread. Plants, which withstand radioactivity better than animals, would absorb it from the air, water and soil. When they died they would return it to the ground. Succeeding generations of plants would yield radioactive tomatoes and asparagus. Stock feed would be poisoned in the same way and eventually you'd be eating radioactive steak and drinking radioactive milk.

Fantastic nonsense? Query Dr. Warren about this and he'll ask if you remember how things were at Krakatao. This South Sea island volcano blew up on August 26, 1883, in a 36-hour paroxysm which belched a mass of rock material estimated at more than a cubic mile in volume to a height of 17 miles. Ashes, lapilli—small volcanic stones—and dust were scattered over a great area, fogging the sun at Bandung, 150 miles away. Upper air currents caught the finer particles and carried them completely around the globe, causing brilliant sunrise and sunset glows in widely scattered parts of the world for months. The dust continued to fall on the earth for years.

If the "Krakatao theory" is too far-fetched, repeat Test Baker in San Francisco Bay, Puget Sound, the Mississippi, Lake Michigan or the East River and what have you got? The prospect of knocking out a key American city in one blow, not just temporarily but for an indefinite time.

You pick a day when a south wind blows and you sneak in and lay a bomb off the Battery in New York Harbor. The explosion blows 10 million tons of water, sand, mud and fragments of fish in a foaming column 2,200 feet in diameter some 6,000 feet into the air. From the base of the column a tidal wave 100 feet high rushes out onto the Brooklyn, Manhattan and Jersey shores, under a cloud of mist. Another cloud kites into the sky. Radioactive rain falls from both, as the wind pushes them north, drenching Manhattan with powerful radiation from 50 different kinds of "hot" fission products. The contaminated area might be 30 to 40 miles long.

(Two days after Test Baker, naval surface craft detected weak radioactivity in rain clouds from 60 to 200 miles away. Very weak radioactivity from Test Able was detected in about seven days in the United States.)

The wave boils over rafts, tugboats, docks, warehouses, the whole water front. Maybe not a single skyscraper falls, but the lethal rain deposits fragments on rooftops, window sills, chimneys, walls, the streets and sidewalks of New York. Everybody on Manhattan Island not killed or maimed instantly by the blast would have to be evacuated in an estimated two hours to escape the radiation. People entered Hiroshima within a few minutes after the explosion, without suffering serious radiation sickness. Members of the Crossroads expedition bathed safely in the lagoon the day after Test Able.

But after Test Baker it was five days before some of the ships in the target array could be boarded. Why? An air burst shoves most of the fission products more than 40,000 feet into the sky; a water burst scatters them over the im-

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mediate area.

There would be panic. (At Hirosbima bridge railings were leveled, not by the blast but by fleeing citizens.) Nobody could tell exactly how much radiation he'd taken. Radioactivity can't be seen, smelled, felt, heard or tasted. Ticking boxes and hard rubber tubes like fat fountain pens—Geiger counters and ionization chambers—can detect charges in a given place but they'd be small help in the initial frenzy.

Manhattanites would suffer two kinds of radiation poisoning, direct and indirect. Those exposed to the explosion would be penetrated primarily by gamma rays, receiving what would amount to an intense X-ray burn. Other survivors, just by breathing the air, eating the food, drinking the water, touching the doorknobs in the area would absorb particles giving off alpha and beta rays. A man might pick up deadly poisonous plutonium fragments through a cut on his hand. (In present bombs only about 1/10 of the plutonium atoms explode; the other 9/10 are scattered around with the rest of the fission products.)

The odds would be fifty-fifty that victims receiving 400 roentgens of radioactivity would die within a month. (Nobody knows exactly what a 100 per cent lethal dose is, but it would probably be between 800-900 roentgens.) Death might come in a few days or not for weeks. There is no cure; no satisfactory way has been found to expel radioactive particles from the body once they get inside. Gradually the victims would develop headaches and mental depression. They would become fatigued, lose their appetites and begin to feel weak, as the radioactivity gave them anemia, destroying the blood-forming organs in their bone marrow, lymph nodes and spleen.

Survivors would of course get far better care than in unprepared Hiroshima, where penicillin and blood transfusions would have saved many who had sublethal doses of radiation but died of complications. The armed forces are training a select group of officers as "atomic firemen" so they'll know how to detect radioactivity, how to move through it with a minimum of danger, what sort of protective clothing is best, how to clean it or dispose of it and what first-aid measures are best. Several universities, including Rochester, Chicago, and UCLA, where Dr. Warren is now establishing a medical school, are planning similar training courses.

Trying to decontaminate Manhattan after a successful water blast would be as hopeless as attempting to sweep away the Sahara's dunes with an ostrich feather. Say they took a block at Thirty-fourth Street and Fifth Avenue and tried to clean it. They might "cool" the street by washing debris into the gutters and then covering the pavement with a thick layer of wet dirt to keep radioactive dust down. But workmen entering the block would track in more radioactive particles. They might try to clean the Empire State Building by "skinning" it—chipping away a thickness of its outside surface. As they chipped they'd get active dust on themselves, on their tools, drive it on into the stone—and scatter it onto the street again.

Could it be that, ostrichlike, we've had our heads stuck in the sands of disbelief about the bomb and are just beginning to realize its potency? "Remember," one U.S. Atomic Energy Commission official

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said, "we exploded the bombs in Japan at a particular height to minimize after-effects. Now we know what someone could do if he set out to maximize them." It took the brass hats at Bikini time to grasp that fact, and some haven't grasped it yet. Officers argued the point with scientists. "How can it be so bad," they wanted to know after Test Baker, "when a lot of the animals are still alive?"

"Follow them around," one scientist retorted, "and watch them drop."

One fine day before Hiroshima, a junior scientist walked into the office of Dr. J. Robert Oppenheimer, then director of the Los Alamos laboratories of the Manhattan Project, and suggested the bomb be exploded near the ground so fission products would mix with the dust and debris, contaminate the city and kill more people. Oppenheimer threw him out.

The doctor's reaction betrayed an anachronistic American attachment to fair play, even in warfare. He was wrestling in deep torment with the ex-cruciating problem of how we could em-ploy the bomb with fullest effect without being accused by the world and ourselves of surpassing the Nazis and the Japs in barbarism. Before President Roosevelt died, he stressed again and again that bizarre aftereffects of the bomb must not be exploited but shunned and that, if and when the bomb were used, it must be made to behave as much as possible like any other bomb, only with more wallop.

## Test Reveals Public Opinion

We've found out since that it has a be-havior all its own, but we haven't con-vinced ourselves that it's true, and as a result Americans as a whole are flounder-ing in a mixture of complacency and confusion. Recently the Social Science Research Council released the results of a nation-wide poll it conducted under the sponsorship of Cornell University on public reaction to the atomic bomb.

One question asked, "Do you think the U.S. will be able to work out an effective defense against the atomic bomb before other nations can use it against us?" Dated shortly after the Bikini tests, 56 per cent of the answers said yes. Twenty-five per cent said, "Don't know," and only 19 per cent said no. Another question was, "How worried are you about the atomic bomb?" Fifty per cent replied, "Not at all," and only one eighth confessed they were decidedly worried.

When London was being mercilessly punished by Nazi V-1 rocket bombs, a favorite story making the rounds con-cerned a man from Limehouse named Jenks, who was asked, a little petulantly, how he managed to remain so calm under the raids. "It's quite simple," he replied. "There's always the chawnce the thing won't get launched properly. If it does, there's a good chawnce the R.A.F. or the Royal Artillery or the barrage balloons will knock it down. And even so, it might not 'it London at all. If it does, it still might not find my street. And even if it does that, it remains for it to find my 'ouse. And of course, if the bloody thing should by chawnce 'it my 'ouse, I shall be down at the pub, 'aving a pint of bitters."

A stouthearted stoic, Jenks, but that won't keep his beer from becoming radioactive next time.



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