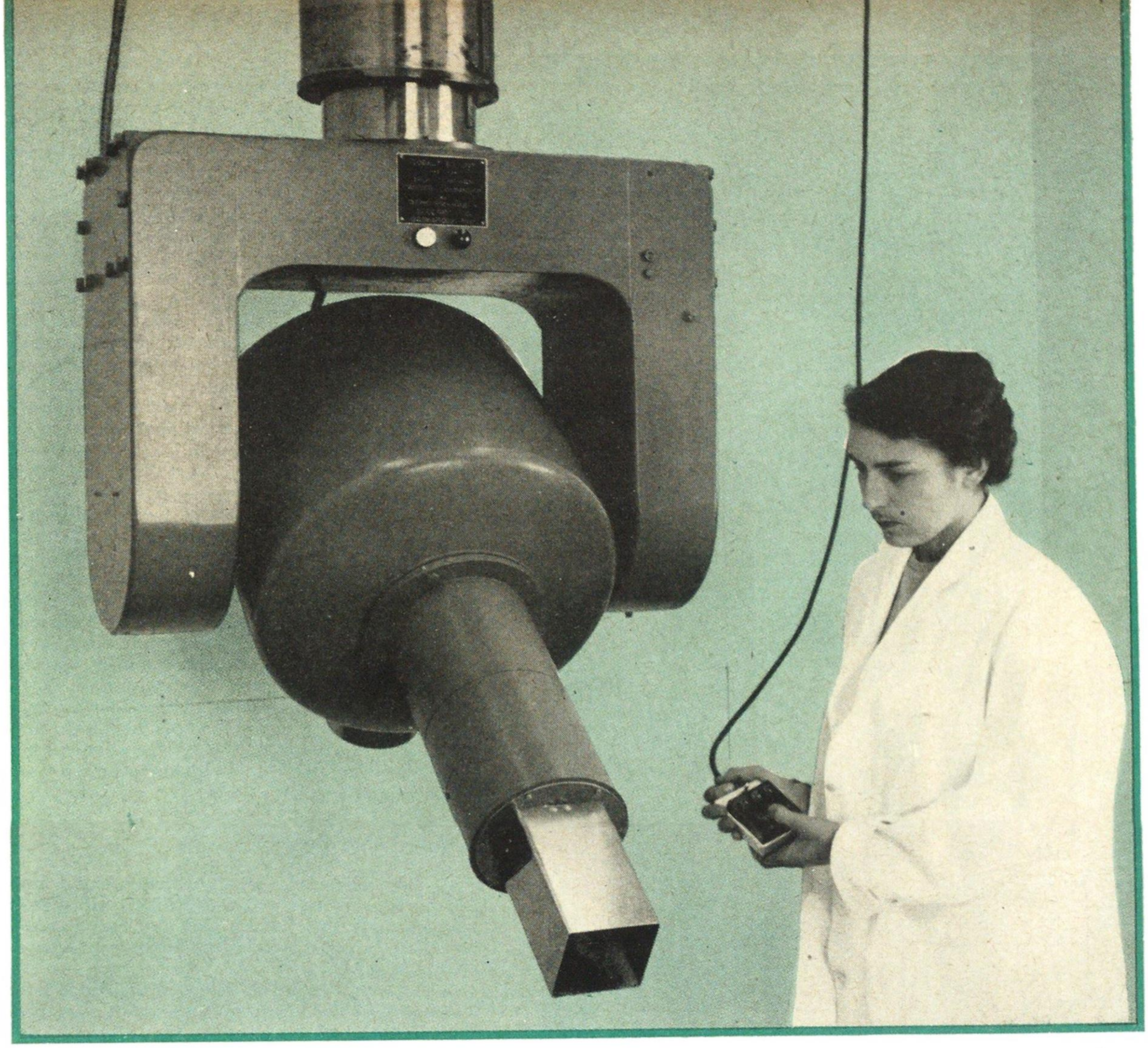


Sylvia Fedoruk push-buttons Saskatchewan's potent cobalt-bomb machine into position to treat a cancer patient.

Physicist Dr. Harold Johns, born in China, designed the anti-cancer bomb, and heads Saskatchewan's pioneer unit. "We asked for it and we got it," he now says proudly.

# The Atom Bomb That Saves Lives

**Canadian scientists have turned the deadly atom into a dynamic healer. Three hundred times more powerful than radium and six thousand times cheaper, radioactive cobalt looks like our best bet yet in the war against cancer. And only Canada is equipped to produce it**

**By ERIC HUTTON**

WORKMEN still swarmed over the new Saskatoon hospital being literally built around a small thick-walled room when nurse Dorothy Hayes ushered in a sixty-one-year-old man. Dr. Sandy Watson motioned him to lie face down on the couch in the middle of the room, then adjusted his position with careful precision. Dr. Harold Johns checked diagrams on a chart, fingered buttons on a panel hanging from the ceiling. Electric motors whirred softly and a barrel-sized lead drum, suspended by a thick telescopic tube from overhead rails, moved slowly toward the couch. The drum's long square snout sought its target until it aimed at an inward angle through the rim of a circle painted indelibly on the man's bare back.

A lead-shielded door closed behind them as the doctor, the physicist and the nurse left the room. Its closing automatically connected the lead drum with a control panel in the next room. Behind the ten-inch-thick glass of his observation window the doctor flicked a switch, turned a dial, and started a time clock calibrated in minutes and seconds.

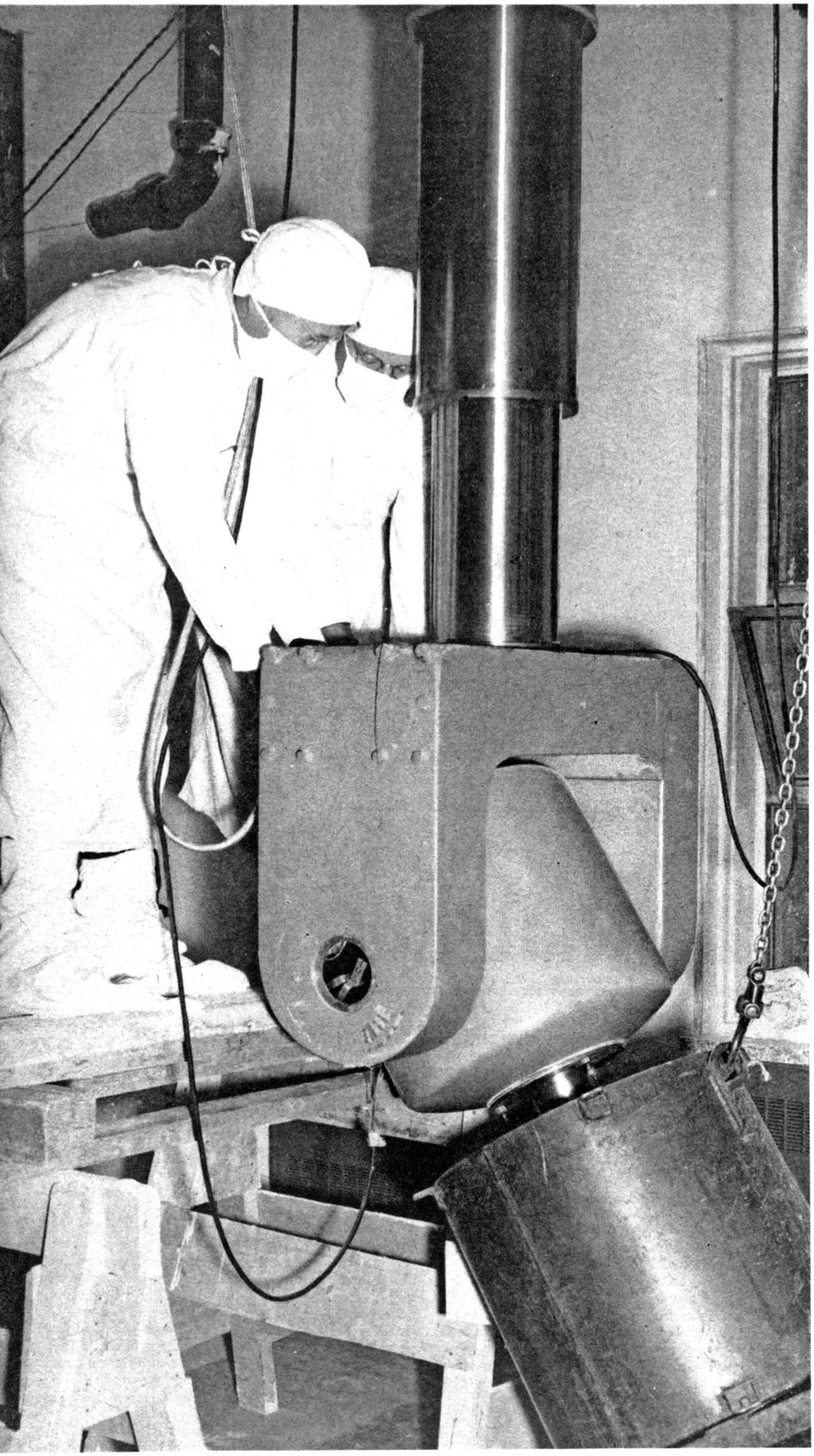
The couch started to revolve slowly. Briefly the drum's mechanism clicked. Then for seven and a half minutes no sound came from the inner room as six hundred million atomic gamma bullets per minute bombarded a cancer deep in the patient's body. In terms of radioactive power, it was as though half of all the radium in the world had been collected to treat this one man.

"Didn't feel a thing," the patient said cheerfully when it was over. "But the bed's a mite uncomfortable to lie on in one position for that long."

About the same time, more than a thousand miles away in an underground room at Victoria Hospital, London, Ont., a forty-two-year-old housewife with cancer of the throat was receiving similar treatment under the second of the world's two cobalt bombs.

Six years after most of the men, women and children of two Japanese cities had been instantly killed or sentenced to slow death by an appalling new weapon, these two Canadians had become the world's first beneficiaries of bomb-sized atomic power. Now more patients are being added almost daily to the list of cancer sufferers under treatment by the newest—and in many ways the most promising—answer to mankind's most insidious disease.

The heart of this beneficent Canadian atom bomb is a half-inch stack of cobalt discs, each the diameter of a twenty-five-cent piece and one fiftieth of an inch thick. The discs have spent a



Masks and gowns screen radioactive dust as scientists transfer "hot" cobalt to Saskatchewan's bomb.

hectic year in the inferno of the world's most powerful atomic pile at Chalk River, Ont. In fact, cobalt bombs can be made in no other pile, since only Canada's "uranium factory" possesses the high rate of flux—volume of neutron production—necessary to energize cobalt units of such size and power.

In the Chalk River pile the cobalt discs have been saturated with radioactivity until they have become veritable stepbrothers of uranium itself. Now they are passing on that borrowed violence to destroy malignant tumors in human bodies.

How violent *is* radioactive cobalt? The radioactive power of the two existing units, physically small enough for a man to conceal in his fist—for a few seconds before sudden death overtook him—add up to slightly more than the combined power of all the medical radium units in the world. Even though they're buried in the centre of a ton and a half of highly absorbent lead, the cobalt bomb's angry gamma particles fight their way out in sufficient numbers to create measurable radioactivity in the room. The bomb's attendants must limit the time they spend in its company to guard against radiation sickness or worse.

But, to understand fully the magnitude of this power which Canadian scientists have harnessed, it must be realized that the "bomb" part of its name is not a courtesy title, nor a mere figure of speech. Produced more quickly and in larger quantities, radioactive cobalt is nothing less than the really hellish ingredient of the Hell bomb, otherwise known as the H-bomb or the hydrogen bomb, beside which the Hiroshima uranium bomb is a damp firecracker.

## A Cloud That Could Kill

It was radioactive cobalt which brought from the world's greatest physicist, Albert Einstein, a warning that "annihilation of any life on earth has been brought within the range of technical possibilities."

Of the cobalt-hydrogen bomb, Professor Edward Teller, one of the Los Alamos scientists who made the preliminary studies on the H-bomb, has declared bluntly: "If it were to be released off our Pacific coast the whole country would be endangered. An enemy could make life hard or even impossible for us without delivering a single bomb into our territory."

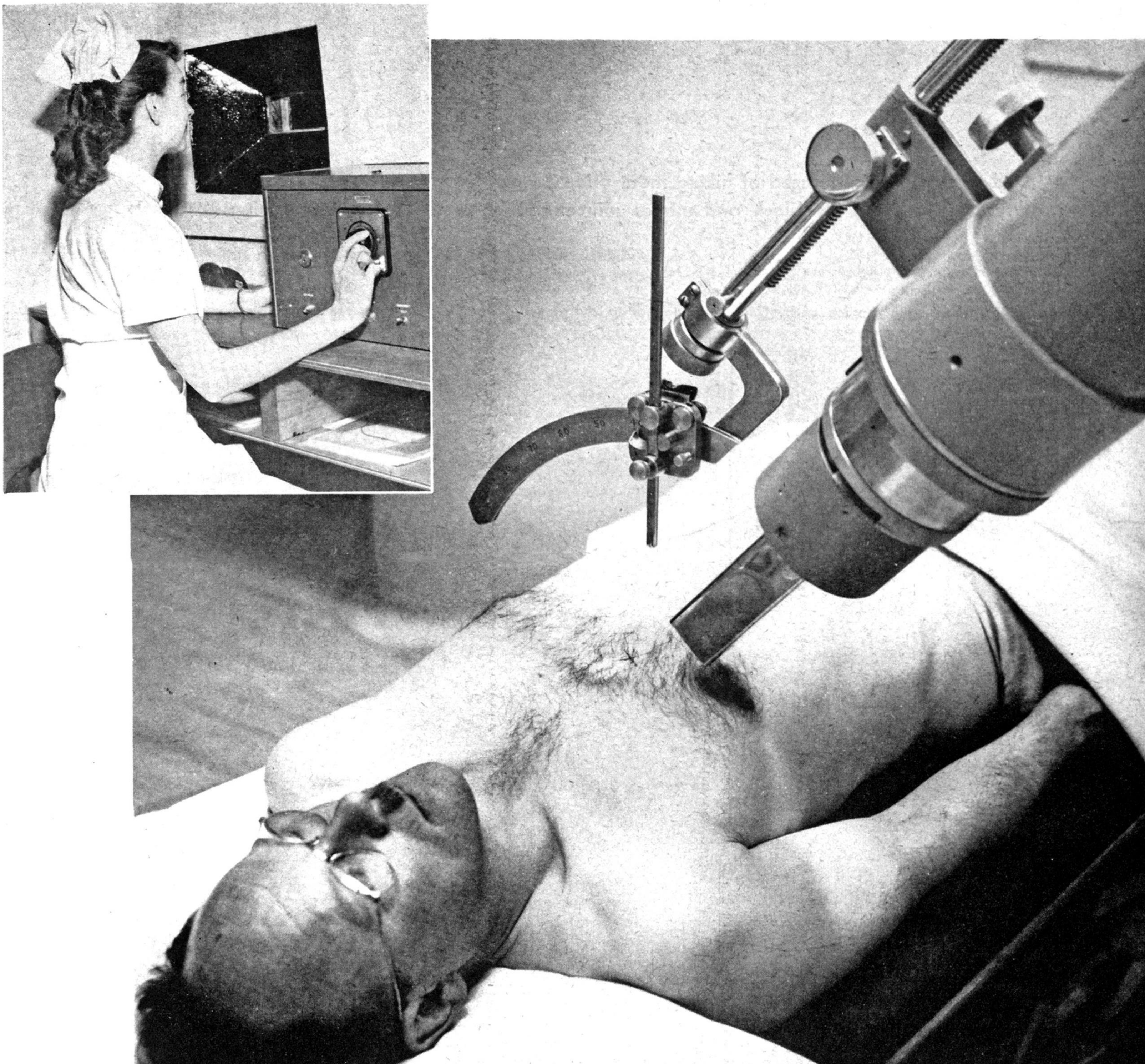
How so innocent a metal as cobalt has suddenly been cast in a Jekyll-and-Hyde role is outlined, as far as the villainous part is concerned, by William L. Laurence, biographer of The Hell Bomb:

> The casing of the bomb could be selected to produce an especially powerful radioactive substance. The very common element cobalt, when bombarded with neutrons, turns into an intensely radioactive element three hundred and twenty times more powerful than radium. Used as a bomb casing, the cobalt would be pulverized and converted into a gigantic radioactive cloud that would kill everything in the area it blankets. The wind would carry it thousands of miles, taking death to distant places.

But cobalt, a fairly common metal, has another quality: under atomic bombardment it converts neutrons into sixty times their own weight of radioactive cobalt. That double multiplication—a sixtyfold increase in neutron weight which in turn becomes three hundred and twenty times more powerful than radium—explains cobalt's tremendous power for good or evil. A modest one-ton H-bomb would produce two hundred and fifty pounds of neutrons, which become seven and a half tons of radioactive cobalt, the equivalent of 4,800,000 pounds of radium—or 4,799,996 more pounds of radium than there is in existence.

The radioactive cloud would haunt the earth for years, attacking human and animal life; poisoning rain, wells, lakes, streams, coastal waters and reservoirs; contaminating homes, buildings, farmlands and crops. In five years its potency would still be that of thirteen hundred tons of radium. And all from *one* H-bomb.

This, then, is the apocalypse which Canadian scientists have cut to manageable size, caged and converted into strong medicine for the sick.



**John MacKay, builder of the Saskatoon bomb, demonstrates how it is used. At top: Nurse Pauline McConkey shows how technicians control the operation through a ten-inch glass window in an adjoining room. Actual patients have reported that they "didn't feel a thing."**

The steps from mass murder to what medical scientists predict will soon become mass therapy are fairly simple, if ultra-astronomical figures don't faze you. The Chalk River uranium pile is literally a huge atom bomb, permanently defused by graphite rods which separate the uranium units and prevent the buildup of explosive temperatures. Inside the pile countless billions of neutrons emitted by the uranium are flying in all directions. When a stable element like cobalt is placed in the pile it becomes a target for the flying neutrons. From time to time a neutron scores a bull's-eye on a cobalt atom, upsetting its stability by leaving a charge of electricity inside the atom. It's only a question of time before that "wounded" cobalt atom explodes violently, giving off a shower of high-velocity beta and gamma particles of energy.

After a year of bombardment most of the cobalt atoms have been hit. Enough, at any rate, to explode at the initial rate of 3,300,000,000,000,000 explosions per minute, and slowing to half that output at the end of five years, three months and eighteen days.

A process of diminishing returns results in a mere six hundred billion radiations per minute reaching the cancer in that patient on the revolving couch. What happens to the cancer when atomic power attacks it is, strangely enough, very like what had happened to the cobalt in the uranium pile. The cobalt's gamma bullets penetrate into the tumor. A few of them (if the term "few" can be applied to any fraction of a figure like six hundred billions) find just the right target; some of the electrons surrounding the atoms which constitute the cancer cells are knocked askew, and these malignant atoms themselves become unstable —ionized is the scientific term.

The cancer cell does not quite complete the cycle by becoming explosively radioactive in its turn. But its instability renders it no longer able to perform like a living growing cell—specifically a cell growing in that unnatural uncontrolled manner which is cancer. It is not necessary to knock out every cell to stop cancer growth. When a certain number have been ionized the rest seem to give up—healthy cells take over and repair the damage the cancer had caused.

Unfortunately, flesh *Continued on page 49*

## The Atom Bomb That Saves Lives

*Continued from page 9*

through which rays pass to reach the cancer is also in considerable need of repair. In fact, healthy tissue has only one small advantage under radiation: its cells are mature, and thus slightly less vulnerable than cancer's growing, younger cells.

The situation is graphically explained in a discussion between a medical student and his professor. Grasping the theory of radiation, the student said brightly: "Oh, it's like finding a man in the coils of a boa constrictor. You take careful aim, hoping to hit the snake and not the man."

"No," answered the professor drily, "you hope to put more bullets into the snake than into the man."

The odds against the cancer are increased by the revolving couch. Physician and physicist carefully correlate the depth of the cancer with the path of the rays streaming from the cobalt inside its lead sheath. That is why the bomb's outlet tube is aimed at the circumference of the circle rather than the centre. As the human target revolves, the path of the rays forms a cone, with the cancer at its apex. Thus all the radiation reaches the cancer, but intervening areas of skin, flesh and other healthy tissue take turns in bearing the brunt.

What the layman will want to know about the cobalt bomb is, of course, "Does it cure cancer?" There are two answers to that question: One is "yes." The other is, "nobody will know for five years." Moreover these answers come, not from opposing schools of thought, but from the same authorities. The apparent contradiction is explained in this way:

The yes answer can be given because radiation therapy is, with surgery, the only method so far discovered to treat cancer successfully. Anyone who survives cancer owes his life to radiation, to surgery, or to a combination of both. And cobalt radiation, still so new that it has yet no roll call of cures to its credit, nevertheless has several points of superiority over other forms of radiation, points so obvious they have already been acknowledged by cancer specialists, the most cautious branch of the most cautious profession.

The wait-and-see answer is part of this caution. It is based on an arbitrary standard set by the medical profession for judging the results of treatment in all cancer cases. No doctor will use the word cure until a patient has lived five years from completion of treatment without symptoms recurring.

The advantages of cobalt are described by Dr. Sandy Watson, director of cancer services for Saskatchewan, one of the two medical men in the world who know most about the cobalt bomb in action. (The other is Dr. Ivan Smith, head of the Ontario Cancer Research Foundation's clinic at Victoria Hospital, London, Ont.)

"First," says Dr. Watson, "cobalt gives a greatly increased depth dose—a very much greater percentage of the radiation delivered to the patient reaches any given depth in the body. With conventional rays, tissues such as bone and cartilage absorb far more of the radiation than surrounding muscle and other tissue, and hence there is some danger of damage to bone and cartilage. The physical properties of cobalt rays are such that an almost equal amount is absorbed by all types of tissues, with less likelihood of damage. For the same reason, much less skin change is produced by cobalt.

"Again because of cobalt's physical properties, the tendency to develop radiation sickness during treatment should be less. Also the cobalt apparatus is compact, simple to operate, its output is constant, it is cheaper to install and there is not the same tendency to breakdown as compared with other high-energy devices."

An important physical property of cobalt is that while it produces far more of the cure-and-damage gamma rays than radium, it also produces only one third as much beta radiation, which damages but does not cure. And cobalt beta rays are so "soft" they are absorbed by the air before they reach the patient's skin. Radium's radioactivity varies through a fairly wide range, but cobalt's is absolutely steady, thus facilitating calculation of dosage and duration for individual patients.

Cobalt's vast output of radiation makes it possible to aim the beam from as far away as a yard or more, thus pin-pointing the target.

But perhaps the most significant advantages of radioactive cobalt—from the viewpoint of doctors, hospitals and patients the world over—are availability and price. How widespread its use may become in the immediate future may be judged by the fact that one uranium pile has been able, in one year, to produce radioactive cobalt equivalent in power to all the medical radium isolated since the Curies made their revolutionary discovery half a century ago. And cobalt worth one cent does the work of radium worth sixty-four dollars.

The birth of the cobalt bomb properly begins in the summer of 1946. The late Dr. Allan W. Blair,

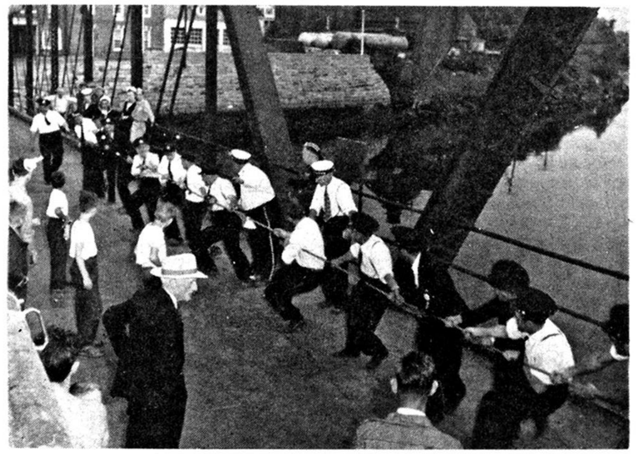
one of the founders of the National Cancer Institute of Canada, was then director of cancer services for Saskatchewan. Dr. Blair was in the midst of developing the province's cancer program into what was to become, before his death, an international model. Dr. Blair decided on a step then almost unheard-of in Canadian medicine: appointment of a radiation physicist to work directly in the medical field.

For the dual role of physicist to the Saskatchewan Cancer Commission and associate professor of physics at the University of Saskatchewan, Dr. Blair selected Harold Johns, then thirty-one, a graduate of McMaster and the University of Toronto.

On the basis of experiments with liquid helium Dr. Johns had won a two-year scholarship for advanced study in England. But the coming of World War II kept him in Canada on a very special assignment: examination by X-ray of vital metal parts of aircraft used in the Empire Air Training Plan.

To indoctrinate his new physicist in the pioneer business of combining physics and medicine, Dr. Blair secured

### C A N A D I A N E C D O T E



Border tug-o'-war (in which Canada, right, forced a draw) exemplifies the co-operation on the Maine line where a fire belongs to everybody.

## The Comrades on the St. Croix

ST. STEPHEN, in New Brunswick, and Calais, in Maine, claim to be the world's best examples of international friendship.

The towns, on opposite banks of the St. Croix River, are linked by a bridge. When there is a fire on either side of the border the fire departments of both communities respond to the alarm. Calais (pronounced "Callus") gets its water from St. Stephen, the supply being piped across the bridge. It also gets its electricity from St. Stephen, and most Calais babies are born on Canadian soil in the St. Stephen hospital. St. Stephen golfers play on the course in Calais. Calais joins St. Stephen in celebrating Dominion Day, and St. Stephen joins Calais in celebrating Independence Day.

Their neighborly relations go back to a Highland soldier, Duncan McColl, who was with the British forces in the American Revolution. During a hot encounter near Castine, Maine, McColl was trapped out in the open. Enemy bullets tore off his cap, tattered his clothing, but he stayed on his feet. Finally a Yankee officer was so impressed that he ordered his troops to stop shooting at McColl because "God must have work for that man to do."

The words were prophetic. After the war McColl attended theological college, then became minister of St. Stephen's first church. His flock was drawn not only from St. Stephen but also from Calais.

When the War of 1812 broke out McColl summoned residents of the two towns to a mass meeting and persuaded them to vote unanimously to take no part in the fighting.

In spite of this the British government provided St. Stephen with guns and gunpowder for its defense. When peace returned the British came around to collect the weapons and powder—and found the powder all gone.

"You must have had it hot and heavy here," an army inspector said to the mayor of St. Stephen.

"No," said the mayor, "we didn't."

"Then where's the powder?"

"Well, I can't tell you that," said the mayor. "It's sort of a secret. But you'll get it back soon."

The army inspector was insistent. He demanded that he be told, immediately, what had happened to the powder. He blustered and threatened.

"All right," said the mayor, soothingly. "The folks over in Calais didn't have any gunpowder to make noises on the Fourth of July—so we loaned them ours. But don't worry, they'll pay it back."—Ian Sclanders.

***For little-known humorous or dramatic incidents out of Canada's colorful past, Maclean's will pay $50. Indicate source material and mail to Canadianecdotes, Maclean's Magazine, 481 University Avenue, Toronto. No contributions to this department can be returned.***

for Dr. Johns a traveling fellowship from the Canadian Cancer Society. Dr. Johns set out on a round of visits to centres where radioactive equipment was being experimented with. At the University of Chicago he saw and studied the betatron, a twenty-two-million-volt monster which was then the most powerful man-made producer of X-rays. The tour ended in Toronto with a lecture by Dr. W. V. Mayneord, one of Britain's top radiation physicists and head of the physics division of the Royal Cancer Hospital, London, then on loan to Canada for some very hush-hush testing projects at the new Chalk River pile.

In his lecture to young Dr. Johns, Dr. Mayneord remarked that radio-activated cobalt showed qualities which made it worth investigating as a cheap, potent substitute for radium in cancer treatment.

"When I got back to Saskatoon," Dr. Johns recalled recently, "Dr. Blair asked me what I had seen or learned of that I would like to get for Saskatchewan. I asked for a betatron and a cobalt unit."

This was approximately like asking for the moon and the sun. But to Dr. Blair nothing was impossible if it concerned cancer work in his beloved province. Without batting an eye he set in motion the machinery which was to give Saskatchewan incomparably more curative radiation per head of population than any other area on earth. The betatron was installed a month before Dr. Blair's death in Nov. 1948.

The cobalt bomb involved considerably more red tape. It was to become a posthumous monument to Dr. Blair's foresight and his tireless efforts to expand cancer research and treatment in Canada.

"We asked for it," says Dr. Johns now, "and we got it."

Actually the process was not nearly as simple as that. First, the Atomic Energy Control Board and the National Research Council, which took over at Chalk River in 1947, had to be convinced that Saskatoon, eighteenth city in size in Canada, deserved the prize of the world's first cobalt bomb. Dr. Johns the physicist and Dr. Watson the medical man presented some cold hard facts:

The clinics of the Saskatchewan Cancer Commission in association with the University of Saskatchewan were training more radiation physicists and radiotherapists than many a larger institution. (In fact, today more than half the radiophysicists in research and clinical posts throughout Canada are "Dr. Johns' boys.") The clinics were among the few places in Canada where physicists and clinicians were working in close collaboration on the treatment of cancer by radiotherapy. The Saskatchewan Cancer Commission's comprehensive program of detection and treatment would provide patients most likely to benefit from a powerful new therapy unit.

The federal government's scientists were convinced. Saskatoon could have its radioactive cobalt—provided . . .

Provided Dr. Johns would work out the "presentation" of the cobalt discs in the pile. That is, the actual pattern of the discs within their containers. This was of crucial importance if the discs were to take up a full charge of neutrons. A miscalculation could mean "cold" cobalt where the neutrons failed to penetrate.

Provided Dr. Johns would design and construct a suitable head to house the lethal cobalt, equipped with delicate remote-control mechanism to raise and lower it, to position it on ceiling tracks, to aim the outlet, to turn the live cobalt within the foot-thick walls of lead so that its tremendous energy would be loosed only when the patient was alone with the bomb.

The physics professor and an enthusiastic group of graduate assistants and student volunteers cheerfully accepted the challenge. For the delicate work of machining dozens of intricate parts and mechanisms Dr. Johns turned to John MacKay, clarinetist with the Saskatoon Symphony Orchestra. MacKay is also owner, and one sixth of the staff, of the Acme Machine and Electric Co. of Saskatoon.

Dr. Johns knew MacKay to be a man of resource. He had come West from Trenton, N.S., in the depth of the depression, opened a one-man machine shop, and prospered. It was later that MacKay confessed he had taken this step because he "didn't know any better." He also admitted, when questioned about a grasp of higher engineering far above the requirements of a master machinist, that his hobby—apart from clarinet-tootling at the symphonic level—was digesting calculus textbooks, taking courses in engineering by mail, and practically nonstop attendance at various Saskatoon night-school classes.

Dr. Johns' chief assistant was, and still is, personable twenty-four-year-old Sylvia Fedoruk. Miss Fedoruk is undoubtedly the only Canadian girl ever faced with the alternatives of becoming an atomic physicist or becoming the country's top feminine athlete.

Her ability to do either was never in doubt. Scholastically she has long since lost count of scholarships won, but "they averaged roughly two a year" for the past ten years. They were topped off by the Governor-General's Gold Medal for the outstanding graduate of the University of Saskatchewan in 1949, and a twelve-hundred-dollar physics fellowship from the Saskatchewan division of the Canadian Cancer Society in 1950. In the same year she was appointed assistant physicist to the Saskatchewan Cancer Commission.

In athletics Sylvia became individual high-point champion of the 1947 Dominion Track and Field Championships, held at Edmonton. She is acknowledged to be western Canada's outstanding girl athlete in every sport—"except swimming," she insists.

But actually her decision was made in high school, when the Fedoruks made a wartime move to Windsor, Ont., and Sylvia entered Walkerville Collegiate. There her science teacher, Howard R. Hugill, "made the subject so interesting that I decided to make science my career."

Other members of the cobalt team were Doug Cormack, son of the Alberta writer Barbara Villy Cormack; Lloyd Bates, an ex-RCAF Flying Officer who graduated so brilliantly from the University of New Brunswick that the province offered to stake him to advanced physics training at any university he chose—and he chose U of S; Ed Epp, twenty-two, whose father emigrated from Russia's Dnieper Basin six years before Ed was born; Stan Denesuk and Gordon Whitmore, physics students.

The two senior men of the team have in common—of all things—a Chinese background. Dr. Johns was born and spent his boyhood in Chengtu, capital of the province of Szechwan in western China. Dr. Watson was born in New Zealand, took his first medical degree there and served in China as a doctor before World War II. Later he went to England to specialize in radiotherapy.

The team had longer than was expected to prepare for the coming of the bomb. But the cause of the delay was good rather than bad news—cobalt proved to have an extremely voracious appetite for atomic neutrons. (Remember, cobalt was later to be found "useful" for Hell bombs because it converts atomic neutrons into sixty times their own weight in radioactive cobalt.) So when the cobalt discs first were placed in the pile they devoured so much of the uranium's output of atomic power—"like the greedy pig in a litter," commented one physicist—that other elements being activated in the pile for medical and industrial research were being literally "starved." It was good news to the Saskatoon team, too, because it proved that the pioneer design for placement of the discs, worked out theoretically in the university's physics department, was highly efficient.

As a result of cobalt's enormous appetite for atomic energy the discs had to wait until the Chalk River pile's neutron production had been stepped up to full capacity. When they finally were inserted, another batch destined for the London, Ont., hospital went in at the same time.

Last summer, with the cobalt hot off the griddle at Chalk River and neatly packaged for shipment in the dead centre of a two-thousand-pound chunk of lead, another serious hitch developed. The fine print on railway bills of lading, it seems, says nothing about the conditions under which atom bombs are to be accepted as freight. The railways, who didn't know what it was, were reluctant to accept the package.

"We can't carry that stuff," said one railwayman in the understatement of the year, "it's dynamite!"

Dr. Johns hitched up his family

trailer and was about to take off for Chalk River, one thousand miles away, to bring the bomb home. But finally the Chalk River scientists persuaded the railwaymen that the bomb was not of a kind likely to explode, and the "package" was accepted—with two conditions: It must go express, so it would be off the railway's hands as soon as possible; and the university people in Saskatoon must unload it themselves.

The homecoming of the bomb caused more excitement on the Saskatchewan campus than a football victory. "I was scared," admits Dr. Johns, "and so were a lot of other people. We worried about dust contamination from the cobalt and a lot of other unknown factors like what would or might happen during the delicate task of transferring the cobalt from the traveling case to the permanent head."

The heavy lump of lead, with its lethal core, was lugged in through the scaffolding of the half-finished hospital and into the bomb room. Team members donned gowns and surgical masks—largely a psychological protection. Then, with Geiger counters serving as contamination detectors, like canaries in a coal mine the two lead containers were brought together. While the assistants waited tensely, a threaded rod was thrust through the permanent head, into the traveling case, screwed into a metal cylinder containing the cobalt, and yanked up into the head with scarcely time for a gamma to escape.

Now the bomb was ready for all manner of research into the behavior of captive atomic power. But before it could be put to work on its most important job—the treatment of cancer—one test remained: determination of atomic power's penetrative power in human flesh. Experiments could not be conducted into this unknown force using human subjects. And laboratory animals just haven't got the cubic capacity to serve as stand-ins for men.

The substitute decided upon is scarcely complimentary to the magnificent human body, since tests showed that its closest approximation is—a tub of water. Aimed into water containers representing the human body, and measured by instruments devised by Dr. Johns and his team, the cobalt rays were accurately plotted on charts. When a patient is to be treated the depth of his cancer is determined and the exact dose and duration of treatment can be read off the chart in an instant. Under the Saskatchewan Government's health plan, treatment is free to all who need it. Each dose takes a maximum of seven and a half minutes. Patients usually take ten of these treatments over a two-week period or longer.

To describe in detail all the tests and findings of Saskatoon's cobalt team would require a book—a book which, incidentally, Dr. Johns is writing as a major Canadian contribution to the newest branch of physical science. Most of the testing equipment had to be invented on the spot, and built from scratch or improvised from aircraft instruments or electronic surplus. As a result a small group of young physicists in Saskatoon are regarded in highest scientific circles as the top authorities on the behavior and characteristics of radioactive cobalt. At present a senior physicist from the great U. S. atomic plant at Oak Ridge, Tenn., is at Saskatoon as a student of cobalt radiation. He will take charge of the world's third cobalt bomb, now being prepared at Chalk River for a Texas medical centre.

Cobalt's only point of inferiority to radium is that its half life is considerably shorter. In a little more than five years cobalt's output of radiation will be down to half its rate when new. And up in the uranium class of longevity half lives reach as near to eternity as the human mind can grasp—thousands of billions of years.

If some—even one—of the more common elements like oxygen, hydrogen or calcium were of a nature that retained radioactivity as long as uranium or rhenium (the latter stays "hot" for billions of billions of years), no life would, of course, yet be possible on earth.

Even if some fairly common elements like iron had long half lives, human life might be confined to a few remote corners of the earth, hiding away from the large areas where lethal radioactive iron was plentiful. But fortunately oxygen shakes off radioactivity in a few minutes; nitrogen in a matter of seconds; iron of various types in from nine minutes to four years. Aluminum gets back to normal in less than ten seconds, copper in a couple of days.

It's these few eternally unstable elements that possibly hold the key to the fate of the world. They were first developed and employed for mass destruction. Now Canada has taken the lead in showing how they can be used for the mass benefit of mankind. ★

# The Atom Bomb That Saves Lives

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