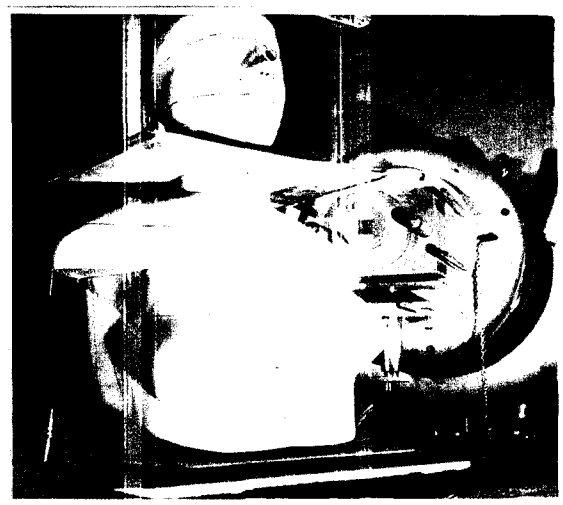
New Weapons Against Cancer—

The X-Ray Cannon and

Physicist John G. Trump (right) and physician Hugh F. Hare (left), who developed new treatment, position a model in revolving chair alongside supervoltage X-ray machine at MIT

the Rotating Chair



Photograph film is put between wood slabs in dummy to measure dosage of X rays

This combination enables scientists to bombard deep-lying cancers with powerful X rays. It's one of the most hopeful treatments yet

By J. D. RATCLIFF

A TWO-MAN Massachusetts team of physicist and physician has combined a giant X-ray cannon and the ancient principle of a merry-go-round into one of the most hopeful methods of treating cancer to be developed in recent years.

Pooling their knowledge, physicist John G. Trump and physician Hugh F. Hare built a device which from outward appearance might have come straight from the pages of science fiction. But in the three years it has been in operation, their machine has brought new hope to sufferers from deep-seated cancers difficult if not impossible to treat by other methods.

Simply put, the Trump-Hare method permits massive doses of X ray to be delivered directly to cancerous tumors with little injury to surrounding tissues. The secret? Revolving the patient on a platform so that powerful X-ray beams may focus constantly on their target while healthy surrounding tissues receive only minor exposure.

X rays have been used for years in treating cancer, but until recently their application has been severely limited. They were excellent for readily accessible growths—as on the skin, lip or tongue—but of limited value for deeper cancers. They might make patients with deep-seated cancers more comfortable and might add a few months to their lives, but too often, that was about all.

Using 200,000-volt machines such as are available in most large hospitals, radiologists always face a dilemma. Cancer tissue is only slightly more sensitive to X rays than healthy tissue. If a radiologist administers too large doses—enough to kill cancer cells—he might also severely damage intervening tissues. The result: X-ray burns which take months to heal or never heal, or even leave holes in highly sensitive tissues such as intestines.

Low-voltage X rays from conventional machines have another disadvantage. They scatter as they enter the body so that the cancer may get very little radiation and healthy tissue a great deal. They can damage, and have damaged, healthy lung, stomach and intestinal tissues severely enough to cause death. Low-voltage X rays have another serious drawback. If the body trunk gets too much radiation, serious sickness generally follows—sickness marked by violent nausea.

Radiologists have used laudable ingenuity in trying to reduce the limitations of their tool. They have used multiple-port X ray, shot at the cancerous target from different directions, and they have stretched small daily X-ray doses over months. But they knew these measures were not the answer they were seeking; in many cases the treatment offered little hope of curing deep cancers. Then in 1949 a brilliant, young (forty-two at the time) associate professor of electrical engineering at the Massachusetts Institute of Technology thought he saw a way around the difficulties.

He was Dr. Trump, tall, blond, wartime head of the British branch of MIT's Radiation Laboratory, which did pioneer work on radar, submarine-detecting devices, bomb-target locators and dozens of other electronics devices.

Trump knew it was possible to build compact X-ray generators with 10 to 20 times the voltage of those in common use—machines in the 2,000,000- to 4,000,000-volt range. Million-volt X rays had been built in the late thirties and early forties, and an experimental 3,000,000-volt machine was built by MIT in 1940. Their beams penetrated deeply into the body and could be focused sharply at any given target with a minimum of scatter.

Another type of supervoltage machine had been used with striking success in the Army's Walter Reed General Hospital in Washington by Dr. Milton Friedman, then a lieutenant colonel in the Army and now head of the department of radiation therapy in New York's Hospital for Joint Diseases. A group of workers at Huntington Memorial Hospital, Boston, had reported similar success with supervoltages. With such machines, focus could be regulated to produce a beam ranging from the size of a dime to the diameter of a dinner plate. With perfect control, it was possible to radiate either the pea-sized pituitary in the center of the head or a cancerous lung.

Trump figured a two-million volt machine would be about right for the cancer treatment he had in mind. Then he had another idea—which he thought was original but which turned out to be at least forty years old. Why not aim an X-ray beam at a target—say a cancerous womb—and then *rotate* the patient? If you did this the cancer would get a 100 per cent dose of radiation while the surrounding skin and other healthy tissues perhaps would get no more than 10 to 30 per cent.

Most radiologists are satisfied if they can hit a cancer with 2,000 to 3,000 roentgens (units of radiation). Trump was thinking of 6,000 to 8,000!

Physicist's Training Was Inadequate

Sitting in his small, cluttered office in the rabbit warren of buildings that make up MIT's Radiation Laboratory at Cambridge, Massachusetts, Trump thought all these ideas looked tremendously inviting. But he wasn't a medical man; he was a physicist. So he enlisted the help of a friend, Dr. Hare, head of the Department of Radiology at Boston's famed Lahey Clinic.

Hare, fifty, is a compact, energetic, friendly man of world-wide reputation. He was born in State College, New Mexico, where his father was professor of chemistry at Agricultural and Mechanical College. He studied medicine at Harvard, and joined the Lahey Clinic staff in 1934.

What did Hare think of Trump's theorizing? There was nothing new about rotating the patient under treatment, he said. That had been tried many times, but only with low-voltage X-ray machines which don't penetrate far into the body. Almost everyone who had tried the idea under those conditions had abandoned it as not worth the trouble. But if you used rotation with the giant-sized X-ray machine Trump had in mind, that was something else again. Trump's ideas looked good, Hare said, really good.

The newly formed team of Hare and Trump took their ideas to the American Cancer Society. The High Voltage Engineering Corporation of Cambridge, a company set up by Trump and other technical men, could build the X-ray apparatus of wanted voltage. It would cost about $90,000. Did the Cancer Society have $90,000 to spare? Fortunately, it did.

The awesome generator, a great cylindrical cannon seven feet long and three feet in diameter, was built to order on the basis of principles developed by Trump's friend and associate, Dr. Robert J. Van de Graaff, and installed in a small building in MIT's crowded back yard. The next problem was to build a turntable chair fitted with clamps which would hold a patient rigidly in position. The chair had to revolve at a constant speed—three fourths of a revolution per minute—so X-ray exposure of the skin would be evenly dispersed around the body.

Various tests indicated X rays penetrated pressed wood almost exactly as they penetrated human flesh. So Trump and Hare—with a team of young physicists and doctors—built a pressed-wood "phantom"—a mock-up of a human body. The phantom was built in layers, so it could be pulled apart. Photographic film—which would measure X-ray dosage—was inserted into the pelvic, lung and other areas of the phantom. Then, when the phantom was seated in the revolving chair and subjected to X-ray bombardment, it was possible to tell exactly how accurately the beam was focused on any particular spot and how much radiation was reaching that spot. Such trials were essential if the researchers were to learn how to hit the cancerous target in human beings.

Months of work went into these preparations before one of the world's most unusual cancer clinics—a clinic associated with an engineering college—opened October 3, 1949. Hare had a patient ready. Indeed the patient had been waiting for two months while final mechanical and engineering details were completed.

The patient was a thirty-three-year-old Boston businessman with cancer of the pelvic bone. He had undergone three operations and all had been failures. Bits of cancerous bone had been left behind and the disease had flamed up again.

Because it is hazardous to give too much radiation at one time, the researchers decided arbitrarily to limit dosages to 280 roentgens at one treatment. Since the total dose they wanted to administer was about 6,000 r, this meant a schedule of 20-odd treatments at the rate of five a week. This first patient kept appointments faithfully and spent 12 minutes at a time being peppered with radiation. Three years have elapsed since the treatment was completed and he is alive and well. If he is still alive and well two years hence, he may regard himself as cured—according to the rigid definition of a cancer cure.

Other patients came along. Because of the time required to position patients properly so the X-ray beam would focus squarely on the target, not more than 15 to 20 a day could be handled. Another X-ray machine was needed, and it was provided by funds from the American Cancer Society; the Godfrey M. Hyams Trust, a Boston philanthropy; and MIT. At present the little clinic is handling 30 to 40 patients a day and has treated a total of approximately 500.

I recently visited the clinic and watched the treatment of a typical patient. In the center of a large, concrete-block room, a young woman sat in a slowly revolving chair, her head and body held firmly in position by wood and metal clamps. The barrel of a giant X-ray cannon was aimed at a pinpoint target: the cancerous

PHOTOGRAPHS FOR COLLIER'S BY MAXWELL FREDERIC COPLAN

Supervoltage X-ray machines now treat deep cancers which surgeons can't reach

larynx in the woman's throat. A 2,000,000-volt stream of X rays—twice as much radiation as could be produced by all the available radium in the world—was passing through the cancer.

Outside the room, a young physicist peered through a foot-thick window, made of a dozen sheets of plate glass. Before him was an elaborate panel, similar to a control console in a broadcasting station. With it, he controlled the motion of the chair and the operation of the X-ray howitzer.

I found that every cancer had its particular treatment requirements, determined largely by its position in the body. A patient with cancer of the larynx may spend only five minutes in the revolving chair, while a woman with breast cancer may spend 15. The number of treatments also varies from 10 to 40, according to depth of the cancer.

Danger in Pituitary Surgery

What results have been achieved? The response to pinpoint X radiation frequently has been highly dramatic. For instance, take pituitary adenoma, a nonmalignant tumor. Tumors on this gland—which rests in a bony socket on the underside of the brain—range from marble size to the size of a Ping-pong ball. As tumors grow, they often cause persistent headaches. In time, they exert pressure on the optic nerve to cause visual disturbances, and finally, blindness. Surgical removal of such tumors is a grave business. The surgeon must make an incision along the side of the head and push the brain aside to reach the pituitary.

With heads clamped firmly in place, 58 patients with pituitary adenomas underwent treatment. In most, improvement in vision was almost immediate. Symptoms disappeared in 51 of the 58, and X-ray pictures gave evidence that the tumors had shrunk and disappeared.

Cancer of the larynx (voice box) responded with similar alacrity. It can be one of the most desperate and distressing diseases found in any large hospital. Where surgery has a chance, the doctor enters the throat and removes the larynx. Here, again, was a small target ideally suited to rotational therapy. Of the first 21 patients treated, 17 are free of symptoms of their disease as this is written. Two are dead, and in two the disease persists despite radiation.

Two-million-volt therapy has also been given a chance at one of the grimmest of all cancers—cancer of the lung. Until 1933, this disease was regarded as being universally fatal. That year a patient climbed on the operating table of Dr. Evarts Graham, of St. Louis. The patient was a physician, a Pittsburgh obstetrician. "I want to be well or I'd rather not get off the table. Be as radical as you like," he told Dr. Graham.

Once the chest was opened, it became apparent that one lung was entirely gone of cancer and that complete removal was the only hope. Such an operation never had been performed successfully, but Dr. Graham went ahead. The patient is still alive.

The principal difficulty with this type of surgery is that by the time lung cancer is recognized, two times out of three the disease has progressed so far that surgery would only hasten death. Radiation had been tried in the past on such inoperable cases; often it only caused additional severe damage to sensitive lung tissues. The story added up: no matter what was done, 17 of 20 lung-cancer victims would be dead two years after their disease was discovered.

Hare and Trump believed supervoltage therapy might be the answer because their more powerful beam could deliver greater doses of X ray directly to the cancerous spot, and smaller amounts to areas of spread. After treating numerous lung cancers, they by no means claim that they have a cure for this distressing and growing problem (lung cancer has tripled in the past 20 years). But they feel that preliminary results merit attention. Of 37 patients treated, 17 are alive and free of symptoms, some for periods up to two years; 19 are dead, and symptoms recurred in one case. Developing the new mode of treatment has often called for a high degree of ingenuity. This was true in treating cancers of the pelvic area: the bladder, pelvic bone and cervix (neck of the womb). The difficulty was that, if the intestine is irradiated, severe injury often results.

"I'm bushed. I think I'll flirt with some good-looking dame so my wife will take me home"

COLLIER'S — LEO GAREL

To get around this danger, Hare trussed the lower abdomens of patients with tight woven elastic bandages, forcing the intestines upward. Patients then mounted the turntable and were held in a standing position. Of the first 32 women who underwent this treatment for cancer of the cervix, 23 are apparently free of symptoms, four have died, the cancer has spread in one and there have been four recurrences.

In cancer of the bladder, results were less heartening, but still good in light of the seriousness of this disease. Of 25 cases treated in the first two years of work, 12 were freed of symptoms, 10 died and the disease persists in three.

Rotational therapy has proved valuable in at least one area unreachable by surgery—the nasopharynx. When cancer strikes in the dark labyrinth where nose and throat join, there is virtually no way for the surgeon to get to it. But X rays have no trouble finding the target. Seven of 10 patients who had cancer in this region are alive and symptom-free—thanks to rotational therapy. The other three died.

Hare and Trump also have given their apparatus a chance with breast cancer, chief cancer killer of women. While surgeons have made notable progress with this disease, the prognosis is still far from good. Only a third of women who have cancerous breasts removed are alive five years after surgery. The surgeon has no way of knowing with surety that cancer in such cases is confined to the breast. It may have slipped out through the lymphatic system that surrounds this organ, possibly entered the blood stream, and planted seeds which will flower and flourish elsewhere in the body.

Hare and Trump knew that straight rotational therapy, of the type used on cancer of the bladder, would have little application here. Why expose the entire circumference of the body to X rays when radiation was wanted only in the breast area? To solve this problem they adapted the rotating chair so it would oscillate—swing back and forth—always keeping the breast area in X-ray focus.

Most patients were women whose cancers had progressed so far surgery would be pointless. A few had undergone breast amputation only to find that the cancer had escaped to surrounding areas. In all these cases, the patients were placed in the chair with their chests bared, and the chair was set to oscillate in an arc that would cover the field to be radiated—possibly even to include the armpits. To date, 20 such women have been treated. Nine are alive and, for the moment at least, free of symptoms—an excellent record by almost any standards. Ten are dead, and there is evidence of spread in the remaining one.

For treatment of widely scattered skin cancers, Hare and Trump developed yet another means of treatment—an electric bed that slides back and forth under an electron (not an X-ray) beam. Electrons penetrate the skin only a few centimeters and hence do not damage underlying structures. Since this type of treatment began only a few months ago, it is much too early to say what final results will be.

Summing up: rotational therapy with supervoltages holds out great promise with adenomas of the pituitary, and cancers of the pelvis, cervix and larynx. And it has turned in less spectacular results with cancers of the breast, bladder, esophagus, lung and ovary. The researchers hold out little hope that it ever will be of great value in cancer of the intestine, stomach or liver; these organs are far too sensitive to radiation.

Rotational therapy has been found to have another interesting application. In a number of cases, it apparently has stopped the spread of cancer without eradicating the primary tumor. Thus it has opened the way for surgery where surgery would have been pointless before. From the patient's point of view, rotational therapy has outstanding advantages. It causes almost no radiation sickness—only two out of the first 50 patients noted slight nausea—and burns almost never occur.

But supervoltage rotational therapy is not a cancer "cure" which will salvage lives of the incurable, or bring back from the brink of the grave those about to die. And a final estimate of the value of this type of treatment cannot be given for another two years. At that time the score for five-year survivals can be added up. A person who is treated for cancer and lives for five years is regarded as cured.

Incurable Cases Not Treated

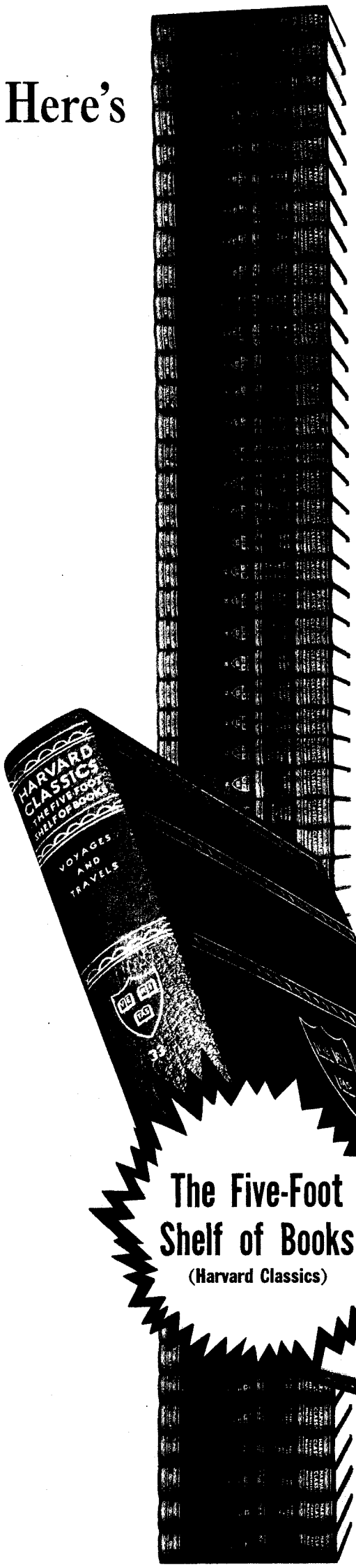
Since the capacity of their clinic is severely limited, Hare and Trump turn down terminal patients—those in the last stages of cancer. They feel their treatment should be given only where it has a chance of success; precious time should not be wasted on hopeless cases.

Some estimate of what others think of the treatment may be gained from the fact that a number of top hospitals are installing similar equipment. Dr. Milton Friedman had rotational equipment, plus a 2,000,000-volt X ray, built by General Electric at the Hospital for Joint Diseases, New York. To date, his results almost exactly parallel those at MIT. Boston's Massachusetts General Hospital and New York's new Delafield Hospital, a unit of the vast Columbia-Presbyterian Medical Center, also have rotational apparatus.

One internationally known cancer specialist, who prefers to remain anonymous, says: "This is in no sense a cancer cure, but it is, by a wide measure, the best method of radiation therapy yet found."

Hare is slightly more optimistic:

"This is the most promising method evolved so far of treating deep tumors susceptible to radiation, including many cases previously considered inaccessible. While the clinical disappearance of the malignancies under treatment has been most gratifying, it must be remembered that a period of years is required to prove any new method of cancer treatment." ▲▲▲



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CELLULOID NUDE

By HANNIBAL COONS

In which Dear George, the irrepressible Hollywood press agent, finds himself mixed up with a stormy actress who wants to express herself at all costs—and at his expense

FEDERAL PICTURES
Hollywood, California
From RICHARD L. REED
Director of Publicity

October 6, 1952
Air Mail

Mr. George Seibert
Special Representative, Federal Pictures
Hotel Driftwood
Vero Beach, Florida

Dear George:

George, it pains me considerably to have to interrupt your vacation. After twenty years of faithful service, a full week with pay isn't one bit too much, and don't think that I consider you slothful. I don't. It's just that a little thing has come up on which I need immediate aid.

As you may know, for once somebody had a good idea around here, and we have just completed an absolutely sure-fire hit called Nude Descending a Staircase. Or, as I shall shortly refer to it in large, rollicking ads, "The Hilarious Story of Modern Art and Modern Artist's Models!" This one, believe me, is in the bag. It's naturally full of nice sets and beautiful girls, but somebody had sense enough to add a little good, wholesome fun for all the family, and the result is a picture so positively entertaining

"Why, George," she suddenly said, "*anybody* would have known that that awful painting was no good. Why, it's an insult to art." And grasping