707113

ATOMIC MEDICINE

1. New Tools for Medical Research

by Carl Dreher

REPOSITORY Oak Ridge Operations
COLLECTION RHTG Class. Docs. 1944-1994
Records Holding Area, Bldg 2714-H Vault
BOX No. RHA H248-7 2 of 3
FOLDER Isotopes

It seems that in 1912 Dr. Georg von Hevesy of Copenhagen was at Rutherford's laboratory in London, experimenting with radiation and radioactive atoms. Hevesy was a bachelor and lived at a boarding house, where the meals aroused his suspicions as a man and his interest as a scientist. One Sunday, accordingly, he brought a little radioactive lead with him to the table and left it with the remainder of his meat. Thereafter, on Monday, Tuesday, Wednesday, Thursday, and Friday, he took a sample of the meat to the laboratory, and on each day was able to find a trace of radioactive lead!

This story is told by a highly reputable nuclear physicist, Dr. M. A. Tuve of Washington, and appears in the austere pagesof Radiology, 35:174; August, 1940, so it may be assumed to be true. The remarkable part of it is not so much that Dr. Hevesy landed in a boarding house which served hash five days in a row, but that it was an early - probably the earliest - application of tracer technique in biology, one which in its current ramifications seems destined to play as large a role in medical research as the invention of the microscope. So, at any rate, say some of the people working with it, and they are not normally given to exaggeration.

Later, in the 1930's, Hevesy was also the first to use radioactive phosphorus in biologic work. That had to await the disclosure by Irène Curie

1019553

and Frédéric Joliot that common elements could be rendered radioactive by alpha-ray bombardment, a discovery which vastly enlarged the scope of tracer technique in medical investigation. The radioactive lead which Hevesy used in 1912 was radium-D, an end-product of the spontaneous disintegration of radium, which meant that there wasn't much of it. Moreover, it was poisonous and hence unsuitable for experimentation on living animals except in the very minutest quantities. But when practically all the elements, including the common organic components such as nitrogen, phosphorus, carbon, sodium, iodine, and hydrogen could be rendered radioactive, the medical researchers really had something to work with.

Isotope Chemistry

The technique of production of these materials is to take a common element, such as red phosphorus, and to bombard it in the cyclotron (or, now, in a uranium pile) whereupon a radioactive isotope is produced. An isotope is a form of an element which differs in atomic weight from the original, because something has been knocked into or out of its nucleus, but does not differ in atomic number, or the electrons which determine its electrical and chemical properties. Thus the common phosphorus which enters the cyclotron is $_{15}P^{31}$, meaning it has 15 electrons revolving in its outer atomic space, and an atomic weight of 31, meaning that it has that many heavy particles in its nucleus. After bombardment with deuterons (heavy hydrogen particles which are themselves iosotopic) the phosphorus which emerges is $_{15}P^{32}$; each atom still contains 15 electrons, (1)but the atomic weight has been raised from 31 to 32.

No chemist can distinguish P^{32} from P^{31} by the older chemical methods, nor can the body tell them apart. As far as assimilation, utilization, and excretion are concerned the two are treated exactly alike. But there is a salient difference; P^{31} is inert, whereas P^{32} is radioactive - it emits beta

1019554

particles, high-speed electrons. It emits these particles at its own pace: in 14.3 days half of them will be gone. That is the half-life of this material, which nothing can alter. While it is emitting it can be detected wherever it goes, in quantities which would defy the most refined chemical analysis. A tracer dose of phosphorus may contain only one atom of P^{32} to every ten billion or every ten thousand billion atoms of some phosphorus compound which acts as a vehicle for it, but those comparatively few radioactive atoms tag it from the time it is taken in through the mouth or a vein, to the time it is completely eliminated from the body. If in the interval it lodges in the skeleton, say, an observer equipped with suitable instruments can tell you how much of it was absorbed there, in what bones and in what parts of those bones, and how long it stays.

There are two advantages in this procedure from a research standpoint. First, it is about a million times as sensitive as the best quantitative chemical analysis. Second, it presents a dynamic picture of what happens in a living plant, animal, or human body, with the organism functioning in its normal fashion. You don't have to cut it up to find out what happened, you don't have to overdose it to get a detectable chemical response. A development which did either of these would be an item for the history books; to have the two combined in a single technique is really momentous.

How Isotopes Are Traced and Measured

A number of instruments can be used for tracing and measurement; the only ones we need consider here are photographic film and the Geiger-Müller counter. Photographic emulsions are fogged by radiation. An elementary use of this property, by which Roentgen discovered the x-ray, is exemplified in the film badges worn by workers in the atomic bomb plants. If the film is found

1019555

to be darkened on development, it means that the wearer has been exposed to radiation and the health authorities in the plant have something to worry about. In a more refined form, photographs can be made of radioactive material imbedded in organic tissue. These are called auto-radiographs, because the radioactive material photographs itself with its own invisible

(2),(3),light.
(4)

Photographic methods have their uses in research and diagnosis, but the Geiger-Müller counter is more sensitive and gives quantitative results. It is an electronic instrument. The counter proper, which is placed over the region to be studied and shielded as far as possible from radiation originating elsewhere, is a glass tube filled with a gas at reduced pressure and containing a fine wire running coaxially through a copper cylinder. The wire is at a potential of about +1000 volts with reference to the cylinder. Penetrating radiation, such as x, cosmic, or gamma rays, will pass readily into the space between wire and cyclinder, where it produces ionization (electrical conduction by knocking electrons out of the gas atoms), with a resulting surge of current between the two electrodes. This is amplified and recorded automatically on a counter, or it may be observed on an oscilloscope, or heard as a click in a pair of headphones. The number of counts per minute or fraction of a minute is a measure of the radioactivity present, hence of the amount of radioactive material, hence of the total amount of material with which the radioactive isotope has been mixed in a

(5) known proportion.

Beta radiation, which is what most isotopes emit, is comparatively "soft," so for it a thin metal window has to be provided in the glass to permit the electrons to get into the ionization space, and the copper cylinder must also be thin. Whatever the kind of radiation under observation, correction has to be made for background radiation, principally cosmic rays,

1019556

which is always present. Under favorable conditions one of these counters can measure down to 1/100 microgram. A microgram is a millionth of a gram,
(6) and a gram is about 35/1000 of an ounce, so this figures out to 3.5 billionths of an ounce. That is real sensitivity.

Isotope Research

Not too much is known as yet about the utilization of iron, iodine, phosphorus, nitrogen, carbon and other elements and their compounds by plants, animals, and man. In each case three general questions arise: how is the substance assimilated, how is it distributed in the tissues, how is it eliminated? In some instances controversies have been carried on for decades without an agreement being reached, simply because the methods heretofore available have not been competent to furnish final proof or disproof of the various theories that have been raised to explain the facts - or what seemed to be the facts.

Thus we know that iron is a vital element in the metabolism of the blood, and there is a vast literature on its transport and chemical conversions, yet such a comprehensive and authoritative work as Howell's text on physiology ends up by declaring, "The whole history of the metabolism of iron in the body is surrounded by much uncertainty." Now radioactive iron is available. This isotope has a half-life of 47 days, giving ample time for study, and it is absorbed like any other iron. An obvious advantage of the tracer method is that it enables the investigator to differentiate between iron already present and the new iron taken up by the blood. It is being used in this way in experiments on normal animals and on animals with artifically induced anemias and a resulting iron deficiency. Absorption is found to be in proportion to need: a normal dog will absorb iron in very small amounts, an anemic dog absorbs it in large amounts and very promptly. It is transported rapidly by the blood plasma from the gastro-intestinal tract. There is

1019557

some indication that in anemic animals it is stored in the muscles. The liver and bone marrow of course play a major part in iron metabolism. Research along these lines promises to clear up most of the uncertainty Howell refers to, and in time the results may be reflected in the treatment of anemia and other blood diseases in human beings.

Even in fields which have been developed satisfactorily by the older chemical methods, isotope studies may furnish more exact data and eventually improve medical practice. A great deal was known about the secretion of iodine by the thyroid gland before the development of nuclear physics, but tracer studies using radioiodine enable us to draw accurate curves of the absorption of iodine by healthy and diseased thyroids. Such studies are particularly important in the case of growing children with abnormal thyroids, since a disturbance in this quarter inevitably upsets the balance of the whole glandular system and interferes with normal development. In another connection, the metabolism of a boy with a severe case of rickets was studied with radiophosphorus. It was found that the patient absorbed bone salts (phosphates) readily enough, but evidently had difficulty in calcifying them. (7),(8)His condition was subsequently improved with massive doses of vitamin D.

The action of drugs labeled with radioactive tracers may likewise be accurately determined. Of course experience has furnished some guidance in the matter of administration by mouth and by vein, but actual figures help. It has been found, for example, that when phosphorus is given by mouth about 25 per cent is lost through failure of the body to assimilate it completely; thus for the same effect that much more should be given than when the drug is injected intravenously. Another practical application of the tagging technique was reported by a team of five scientists in the Journal of the American Medical Association for January 8, 1944. It was already known that failure of some diabetics to respond to insulin was due to failure to absorb the drug quickly enough after injection, and that in certain cases this was

1019558

due to the practice of injecting repeatedly in the same areas. Pads of fat developed under the skin at these points, making the injection painless and encouraging the patient to continue using that same spot. The only trouble was that the pads also retarded the absorption of the drug. Exactly how much was determined by marking a 3/4-inch mercurochrome ring on the skin, in the center of which a standard injection was made. The Geiger-Müller counter was then placed over the marked ring and the count recorded; this was repeated at intervals of 20 minutes, 1 hour, and 2, 4, and 8 hours. Thus the rate at which the insulin left the injection site was accurately measured. It was found that after two hours, instead of absorbing 40 per cent of the insulin, one patient had absorbed only 10 per cent. Of course he was not getting enough insulin, and his sugar content rose accordingly. These tests showed that the advice given to diabetics to rotate areas of injection so that a given site is not used more than once a month is no mere flight of fancy on the part of the physician.

Drs. Alfred Marshak and R. L. Byron reported in the Journal of Bone and Joint Surgery for January 1945 on studies of the healing of bone made on rats. The animals were anesthetized and lengthwise cuts made in their leg bones with a small circular saw. During recovery they were fed radiostrontium and radiophosphorus; the former behaves the same as calcium and is more convenient to use. The uptake of these substances by the healing cut was measured with a Geiger counter. The results indicated that the time required to reach a maximum uptake might be used as a measure of healing. Presumably this could lead to evaluation of the mending of fractures in human subjects.

Radiation Research

Tracer technique is not the only contribution of nuclear physics to medical research. There is also the direct radiation from the cyclotron and other nuclear transformers, which may prove preferable in the treatment of

1019959

some cancers to the older types of radiation generators, such as the x-ray tube and radium. Before this was possible it was necessary to collimate the output of the newer devices, to project the particles in a beam which could be directed on a target. We can now irradiate organic tissue with neutrons from the cyclotron, or with radioactive substances produced by the cyclotron or the uranium pile, and no doubt direct radiation from the pile could be used with suitable appliances or modifications.

But control of the radiation from such sources is only a beginning. It is equally necessary to know how much can be used safely, to standardize dosages, that is. In some instances the answers are known; others are still in the stage of animal experimentation. One method is to cultivate malignant tumors in mice, expose fragments to definite quantities of radiation about which information is sought, transplant the fragments to healthy mice, and compare the proportion of resulting "takes" with similar tumor sections exposed to x-radiation. It takes thousands of tests of this sort before application to human beings can be thought of.

* * * * * *

These are only a few samples of the work being done. We are often told that such and such a field is in its infancy. The statement frequently has little validity; technological progress is more rapid nowadays than it used to be. But in the case of isotope chemistry applied to medical research it is literally true. Artificially produced isotopes have been available over a period of less than twelve years, during the first part of which they were produced in such minute quantities that only a few laboratories and investigators could get enough to learn their use. Soon after the investigators had developed their techniques and the materials began to be available in practical quantities, the war came, and long-term medical research took a back seat for four years. E. O. Laurence tore apart his big cyclotron, from

0019560

which a good part of the isotopes used in medical research had come: the electromagnet was needed in the atomic bomb project. Most of the nuclear physicists went with the equipment, and may of the research teams of physicists and physicians were broken up just when they were beginning to produce. It was all necessary and inevitable; fascism was a worse disease than any they were working on. But it was a setback.

Yet it may have been bread cast upon the waters. Those same four years produced not only the atomic bomb, but a prodigious amount of experience in nuclear physics. Much of this know-how and equipment is directly applicable to medical research. At one leap we have moved from the age of scarcity in radioactive materials to the age of plenty. It is said that as far as production of neutrons is concerned one chainreacting pile is the equivalent of a millon cyclotrons, and a goodsized cyclotron is the equivalent, for some therapeutic purposes, of about 200 pounds of radium! (The world stock of radium in 1940 was two pounds.) That may serve as a rough measure of what has been accomplished.

Now we have, potentially, more radiation than we can use. Isotopes can be furnished in practically unlimited quantities. Heavy carbon, C^{13}, for example, a half-gram of which had been isolated in 1943, is to be produced by the Sun Oil Company in association with Houdy Process at the rate of 500 grams monthly in one plant, and furnished, cost-free, to non-commercial biological and medical research groups. And all the other isotopes required for medical research can be turned out on the same scale. If we prove capable of an intelligent appreciation of the vital importance of research, as much in the biologic as in the industrial sciences, and if medical needs are not lost sight of in a phantasmal pursuit of complete military security, scientific medicine is sure to make great strides in the understanding of its subject matter, and. eventually, in the conquest of disease.

1019961

ATOMIC MEDICINE

REPOSITORY Oak Ridge Ops
COLLECTION RHTG Class. Docs. 1944-1994
Records Holding Area, Bldg 2714-H
BOX No. VAULT RHA H2-48-7 2 of 3
FOLDER Isotopes

2. Treatment of Disease

by Carl Dreher

There is no royal road to therapy. Optimistic expectations that recent developments in atomic technology will lead to a quick and easy solution of the more intractable problems of medicine are doomed to disappointment. For that matter, "atomic medicine" is no more than a convenient phrase. Medicine has always borrowed its principal tools from physics, chemistry, and industry. The radioactive isotopes and the new forms of radiation are merely the latest contributions of the natural sciences to the art of healing. They are extremely important, but there have been important ones before and people still get sick and die.

The very fact that in medicine the toughest assignments always go to the latest arrival is a reason for not getting too jubilant. Nobody is calling on nuclear physics for help in combatting the ravages of chickenpox and poison ivy: it is the heavyweights like leukemia and cancer which we have to deal with. And here the words of the father of medicine are still applicable: "Life is short, art long, opportunity fleeting, experience treacherous, judgment difficult." Organized research has made the opportunity less fleeting; the rest is much as it was. Maybe we do stand on the threshold of a revolution in medicine. If so, it is a revolution which will take at least a generation to complete.

One more word of caution before we look at the brighter side. Abundance of radioactive materials will bring hazards in its train as surely as

1019562

benefits. These are lethal agents, not only against disease, but against anyone who gets in their way through careless or ignorant use. Do you remember, in the 1930's, the people who drank radioactive waters for some added pep? You can only remember, not see them, today: they died very shortly. Even experienced radiologists have to watch their step constantly lest, a few roentgens here and a few there, they accumulate enough radiation to make them sick, or to kill them. The splendid safety record of the Manhattan Project must not lull us into a feeling of security: that was the result of first-rate medical supervision, tight military control, and unrelaxing vigilance. Everything - the people leaving the plants, the coats of the laboratory technicians, the furniture, the water, the very dust in the air- was tested for stray radiation. We don't have to make the country a Manhattan District, but we do have to see to it that radioactive products are released only to people who know their dangers as well as their potentialities.

Leukemia

Leukemia is not cancer, but it resembles cancer in its uncontrolled multiplication of one group of cells to the disaster of the organism as a whole. The cells in this case are the leucocytes or white corpuscles of the blood. Leucocytes are necessary; they fight infection and have many other important and complex regulatory functions. But not many are necessary; in normal blood there is only one white corpuscle to every 500 or 1000 of the red. In leukemia the white cell count increases out of all proportion, and at the same time the cells fail to mature properly. The blood can no longer do its job of nourishing and repairing the tissues and carrying off their waste products. It is as if the military police set out to run the army.

There are several distinct types of leukemia. For the acute form there is no treatment whatsoever. In chronic leukemia there is more hope,

1019563

but no satisfactory treatment has been devised. Benzene and arsenic have been used, but in recent years the principal therapy has been whole-body or "spray" x-radiation. This often dampens the exuberance of the leucocytes, but the dosage required is so high that radiation sickness is the rule. Skin burns are also possible. The physician has to steer a precarious course between keeping the leucocytes in check and damaging the patient with excessive radiation.

Radiophosphorus was first tried in 1936. The principal work in this field has been directed by Dr. J. H. Laurence of the University of California. (Don't confuse Dr. J. H. Laurence with Dr. E. O. Laurence, the cyclotron man, of the same institution.) The idea was to get a radioactive substance into intimate contact with the leucocytes, so that they would be strongly irradiated, the rest of the body less so. The results are about equivalent to those secured with x-rays, with apparently less liability to radiatron reactions. But it is still touch and go: where skin damage is the limiting factor in x-radiation, with radiophosphorus one has to watch out for damage to the bone marrow, where the agent tends to concentrate. More recently radiosodium has been used. Radiosodium expends its energy in about as many hours as radiophosphorus takes days. The results have not yet been reported.

Polycythemia Vera

This is leukemia in reverse; it is the red cells which get out of hand. Radiophosphorus has been used in its treatment in the same way. The results have been distinctly encouraging, but since the disease is rare not many cases have been treated. If too much of the material is given the treatment will overshoot and produce anemia, and the same danger is present of damage to the bone marrow as in leukemia. The chances are, however, that when radiophosphorus, or a better internal irradiator, is made available to physicians, this will become a recognized method of treatment.

1019594

Peripheral Vascular Disease

Vascular refers to the blood vessels and peripheral to the outlying ones, in particular those of the legs. All parts of the body are dependent on continuous and ample blood supply for life; the lower extremities are peculiarly liable to trouble in this respect, since they are farthest from the heart and more things can go wrong on the way. Aside from diseases of the vessels themselves, prolonged immersion and exposure can get the legs and feet into grave trouble. There were many such cases in the merchant marine and the air forces during the war.

When gangrene has set in it is often necessary to amputate. This poses as excruciating choice for the surgeon as well as the patient. He may know he must amputate - but where? There is a great difference between taking off a leg above the knee or below as far as restoration of function is concerned, and many of these patients are young men who are going to live a long time with their artificial legs. But if the blood supply is not good enough to enable the wound to heal, the knee will have to be sacrificed in a second operation, with all its additional suffering, discouragement, and danger. Overly conservative surgery is, then, a mistake second only to radical surgery when conservative measures would have had a reasonable chance of success.

What the surgeon needs is some objective method of measuring the circulation of the blood to supplement his clinical faculties. Such a method has recently been reported by Drs. Beverly C. Smith and Edith H. Quimby of the College of Physicians and Surgeons of Columbia University (Radiology, October, 1945.) A tracer dose of radiosodium is injected into the patient's arm. A shielded Geiger-Müller tuber has previously been positioned against the instep of the foot. An electric stop clock is started simultaneously with the injection, and counts per minute are recorded for the next hour. Radiation from the foot increases rapidly at first and then more slowly.

1019569

A series of such runs on normal subjects establishes normal circulation time in the form of a family of curves. There is considerable variation between subjects, but the highest readings are only about 50 per cent above
(1) the lowest, and the results - in normal subjects - are the same for both feet.

When something goes wrong with the circulatory apparatus the curves usually, although not invariably, fall outside of the normal range. More often than not they are on the low side; the build-up of radioactivity in the feet is too slow. The curves, of course, do not present a complete clinical picture. The counts may be deceptively raised, for example, by such conditions as fluid in the tissues (edema or dropsy), even though the circulation has been impaired. The physicians has to interpret the findings in the light of his experience and his knowledge of the individual case. But the technique does give him the assurance of an impersonal assessment of the circulatory situation, and thus represents an important advance in the handling of a group of painful, disabling, and often fatal conditions. It is hard to see how this could have been accomplished without the use of radioactive isotopes. Moreover, the method has wide reference in the
(2),(3)(4) future study of the circulatory system.

Cancer

We can usually cope with disease caused by invasion of the body, or failure of some organ to do its job. At least the problem is specific: kill the invading agent, supply the deficiency. In cancer the strategic situation is much less favorable. Cancer is not war, but revolution - and, at least from the individual's standpoint, a perfectly senseless revolution. Or it may be regarded as a kind of perversion of a process necessary to life, the process of growth. Cancer cells are different from normal cells, but the two resemble each other more than they differ. Normally there is some control, the nature of which is still obscure, which keeps the cells growing at the

1019966

right pace and in the right places. When this control fails in a particular organ or tissue, we have a tumor or neoplasm. If the tumor is malignant, capable of spreading or metastasis, then we have cancer. But the opposite number of cancer is not normal growth. It is gangrene, the death of tissue through inability to multiply and maintain the physiological status quo. Health consists in maintaining a balance between the two extremes.

It is highly improbable that we shall ever achieve a cancer "cure" in the medically illiterate layman's sense of something that comes in a bottle: the cancer sufferer takes it and his cancer dwindles and disappears. This does not mean that we are utterly helpless before the ravages of cancer, or that atomic medicine holds out no hope of improvement in our methods of dealing with the disease. It does - but not tomorrow or the next day. It will take time. Less time or more, depending on whether we continue with cancer research on what Dr. Shields Warren has aptly called a "shoestring scale," or whether we decide to put real money, manpower, equipment, and effort into the job, as if it were an atomic bomb, say, or at least a new model of automobile. As it is, we don't even know the electronics and chemistry of normal cell division with any approach to completeness, so how can we know what happens when the process goes haywire?

The atomic methods which are in current use in cancer therapy are: 1) External irradiation, in the form of regulated exposure to x-rays, or other radiation from sources outside the body, or by a foreign body, such as a needle or capsule containing radioactive material, which is implanted in or transported through the body; 2) Internal irradiation, by administration of radioactive material which may be absorbed organically by cancerous tissue, which will thus receive radiation at close range.

The first is by far the most important at the present time; it is the only one. as a matter of fact, which ranks as thereapy. The other is experimental.

1019561

Recent research has not contributed anything startling to external irradiation. We do have new and largely untried forms of radiation, in particular neutron streams, but, while it is too early to be certain, such experience as we have with them does not indicate that they behave in a radically different way from x-rays. If we could find a form of radiation which would damage malignant tissue and spare normal tissue, that would be the answer. Failing that, we must resort to what amounts to differential damage. Fortunately there is a tendency for malignant tissue to suffer more than healthy tissue under bombardment, and where this difference is appreciable radiation therapy is proportionately effective. There is always the chance that among the various particles which we are learning to direct and control, something will be found that will give a significantly better differentiation. But we haven't got it yet.

Internal radiation is active at the moment on a quasi-therapeutic basis. The technique as such is not new. Radium salts were tried unsuccessfully in that fashion some 40 years ago. One drawback was expense: radium is worth $25,000 a gram. A more serious difficulty was that since, for all practical purposes, radium remains active indefinitely - the half-life is 1550 years - it would do indefinite damage if it stayed in the body.

But now we have the radioactive isotopes, which are comparatively inexpensive even when produced by the cyclotron, and as a by-product of the uranium pile should be really cheap. Their half-lives vary from a few seconds to several months or years, giving a wide range of periods of activity. Phosphorus and iodine in particular have a convenient half-life of about two weeks.

Moreover, some of the isotopes are selectively absorbed - iodine by the thyroid gland, iron by the red blood cells, sodium by the spinal fluid and blood plasma, phosphorus by the bones, liver, leukemic cells, and various

1019568

neoplastic tissues. The possiblity thus raised is as obvious as it is attractive: let the cancer absorb the appropriate isotope and burn itself up. The real stuff, of course, would be something which neoplastic tissues would absorb avidly and to which normal tissues would be impervious. That would be the counterpart in internal radiation of the perfectly discriminating external radiation already mentioned. Unfortunately nature does not seem to work that way.

However, the materials now known would permit the treatment of some cases - provided the differential absorption ratio (dar) is large enough. It has been estimated that if this ratio is 6 or above, the material can be used as a primary therapeutic agent. At lower levels, say from 2 to 6, it could be considered as an adjunct to x-ray therapy. "The possibility of using radioactive elements in various compounds which might localize in certain tissues," say three of the investigators in this field, "is an unexplored territory with great potentialities."

At least one case has been reported (by Drs. Frantz, Ball, Keston and Palmer in the Annals of Surgery, May, 1944) in which this method was tried as an auxiliary to x-ray treatment, but only in tracer quantitites which could scarcely have had much thereapeutic effect. The patient had had a thyroid tumor, apparently malignant, which had been removed surgically; after about seven years it reactivated and spread to the right thigh bone, the spine, and elsewhere. The spinal growth caused paralysis. Radiciodine was given, and, as shown by the Geiger counter, was taken up by the thyroid and by the thigh bone metastasis - but not by the other growths, and on a second attempt the thigh bone also rejected it. the patient died after almost two years of treatment. The results of the radioiodine treatment were inconclusive, but since the material was localized to some extent, they were not negative. The reporting physicians recommended further tests in selected cases.

1019969

A pathetic note occurs in connection with this case. The patient was a Negro houseworker about 40 years old. "The patient had great faith in the radioactive iodine," the report reads, "and thought that further dosage might relieve her paralysis. It was not possible to obtain sufficient material for therapy, but two more tracer doses were administered as psychotherapy. . . ." For encouragement, that is. There is no likelihood that a large dose would have prolonged the life of this patient: she was pretty far gone when she came for treatment. But if they had had more radioiodine the physicians would certainly have given it to her. At all events, if the Manhattan Project is properly directed, radioactive materials will be available for treatment whenever indicated, and there will be no limit on dosage except a physiological one. In a few years we shall know more about the possibilities of selective internal irradiation.

Drs. Andrew H. Dowdy and William F. Bale of the University of Rochester, both experienced radiologists connected with the medical department of the Manhattan Project, have recently spoken hopefully of the longer term prospects in the field of atomic cancer therapy. They do not believe that radioactive isotopes in themselves are the answer. But they do suggest that by using isotopes like carbon and hydrogen (C^{14} and H^{3}) it will be possible to investigate many compounds, existing and to be synthesized, in an effort to find one having a high degree of toxicity for malignant cells relative to normal cells. They think a combination chemical and radiation effect may work.

Advocating Federal sponsorship of nuclear research in cancer, Dowdy and Bale sum up in these words:

"The atomic age, for better or worse, is here to stay, and, with its attendant benefits to humanity in the solution of the cancer problem, it offers both an opportunity and a challenge to medical science, to the community and the nation."

1019570

That is good to hear. Hope, after all, has its biological justification as well as its dangers. And where there is hope, there should also be life enough to meet the challenge.

1019571