University of Glasgow

Degree of M.D.

Thesis on

RADIUM DISTANCE THERAPY

IN THE TREATMENT OF DEEP-SEATED MALIGNANT GROWTHS.

WITH A SPECIAL STUDY OF THE TREATMENT OF METASTASES.

Submitted by

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The term "Deep-seated Malignant Growths" is used to include those tumours which by reason of their distance below the skin, are practically immune from the effects of surface irradiation and inaccessible from the point of view of interstitial irradiation.

At least one gramme of Radium is required since the employment of smaller quantities would prove uneconomical on account of the abnormally long time factor involved.

As Resident Medical Officer in the Radium Department of a London teaching hospital, I have for the past eighteen months been actively engaged in the application of this method of treatment with a 2-gramme Radium Bomb. I now propose to investigate the position and usefulness of Radium Distance Therapy in our present day armamentarium against Cancer.

While a great deal of investigation has been carried out on other forms of Radium treatment and much written on the subject, the question of Distance Therapy seems to have been neglected up to the present, and relatively few workers have published their results. In consequence, the use of the treatment, its limitations and its technique, are not widely appreciated, and I therefore feel that a survey of about sixty cases of Malignant Disease treated by this means under my care would prove of some value.

The scope of Distance Radiation has been hampered and unfortunately must remain so, on account of the large quantity of the element required, and its high cost.

This is indeed a pity from the point of view of the operator as well as the patient. The former has in the Radium Bomb a means of attacking

tumours which are too deep-seated to receive adequate radiation from plaques, while at the same time his source of activity can be well screened and is less dangerous to himself and his assistants, in that the element does not require handling at close range. This is surely a notable step in advancement in view of the disastrous results that have followed the manipulation of unscreened Radium in the past. The patient, on the other hand, is spared the pain and discomfort of the interstitial method, and the inconvenience of wearing a probably heavy and uncomfortable plaque for many hours each day. These points I have found greatly to be appreciated by the patients.

I have also found the benefit of being able to have patients attend the hospital for an hour per day to receive their treatment, whereas those treated by interstitial needling or plaques must of necessity be in-patients in order to guard against the possible loss of Radium.

Innumerable factors must come under consideration before a growth can be satisfactorily and adequately irradiated. To deal with the subject in all its spheres, an extensive knowledge of Atomic Physics, Pathology, Biochemistry and Surgery would be required, so an attempt must be made to correlate as many of these as are necessary for the satisfactory application of the "Bomb".

Gamma radiation from a small source would appear to obey the "Inverse Square Law", so that the intensity falls off very rapidly as the source is left behind. It follows, therefore, that in delivering a lethal dose to a tumour situated several centimetres below the skin surface, the skin

traversed by the rays must receive a much larger dose than the tumour, resulting in possible necrosis and a "Radium Burn". This is one of the disadvantages of plaque radiation. When a beam of rays of narrow diameter is used, and the skin over the tumour divided into a number of areas, it is possible to employ the "cross-fire" method of treatment using the skin fields in rotation, and thereby allowing a refractory period during which the superficial tissues are able to recuperate. Resulting from this, a larger total dose may be applied to the growth while at the same time preserving the skin in a relatively healthy state.

These are the basic principles of Distance Therapy - a narrow beam and multiplicity of ports of entry.

The scope of the treatment has, of course, been appreciated, as was also the impossibility of treating very deeply situated growths with the relatively small quantity of Radium available. In view of these facts and in an attempt to obtain the maximum benefit from the Radium, whether palliative or curative, a certain degree of selection has been exercised on the cases presented for treatment.

I intend to discuss the use of the "Bomb" in those cases where some improvement could be expected, although in most instances inoperable.

I propose dealing with the subject under the following headings :

1. The history of the development of Radium Distance Therapy.
2. The Pathology of Irradiation and of the various types of tumour treated.
3. The Technique employed in the administration of the treatment.
4. The Results obtained.
5. Review of Results.

HISTORICAL SURVEY.

In 1896 while the Curies were engaged in measuring the ionisation produced by Uranium and Thorium compounds, they noticed that a particular specimen of pitchblende showed a higher radioactivity than could be accounted for by its content of Uranium. They deduced that the specimen contained some impurity which was more radioactive than the parent substance, and further investigation was, in fact, successful in proving the existence of a hitherto unknown element; to this they gave the name "Radium" in 1898. (1)

In 1901, Becquerel, a colleague of the Curies, accidentally produced upon his abdomen the first recorded Radium burn, by carrying a tube containing the element in his vest pocket. This incident led Pierre Curie to investigate the physiological properties of Radium and by exposing his arm to the rays, he produced a similar burn which took several months to heal.

The first therapeutical use to which Radium was put was the treatment of Lupus and other skin conditions, in Paris. It was used tentatively with occasional success in surface growths, but not until 1907, when Dominici and his colleagues began to interpose filters of Lead and Aluminium between the source and the skin - to absorb the alpha and beta rays - was any definite progress made. (2), (3).

It was about this time that Wickham, in Paris, employed for the first time the "cross-fire" principle. (4). This is of particular interest to us in our present consideration of Radium Distance Therapy, for it is by utilising this cross-fire principle that we are enabled to deliver a lethal dose to a deeply situated tumour without also destroying the skin traversed

by the rays in reaching the tumour. But, of course, Radium bombs were unknown at this time.

Until about 1907 all Radium therapy had consisted of surface application, but in that year Abbe, in New York, inserted Radium tubes directly into growths (5) and in the following year Duane employed Radium emanation (Radon) in a similar manner. (5).

Tubes were later, to some extent, replaced by needles with cutting points and eyes in an attempt to limit the "surgery of access" required to insert them. As experience was gained in the physics of Radium, it became clear that in the case of a tumour treated by the interstitial method, the area immediately surrounding each needle received radiation at a much higher intensity than areas more remote. The lack of uniformity of dosage is one of the faults of this method.

The primary growth could, in many cases, be made to disappear with local treatment, but it was realised as impossible to treat multiple metastases In an attempt to achieve this, however, some workers administered Radium salts internally. Martland (6) in the United States, has since made a study of the effects of the internal administration of Radium, and he believes that soluble Radium salts are converted into insoluble salts in the blood and deposited in the skeleton. The patients usually die of a severe anaemia, due probably to the tremendously destructive action of the unscreened alpha rays. As a therapeutic measure it has now been given up.

Within recent years surface application has again been developed in an attempt to obtain a more uniform field of irradiation than is possible

with needles interstitially. Edling in 1921, made plaques of Dental Compound with which it was possible to maintain a fixed Radium - skin distance. Columbia Paste - a mixture of beeswax, paraffin wax and sawdust - was later introduced as the basis, since it serves the double purpose of diffusing the gamma rays and stopping the secondary beta rays. The plaque is moulded to fit the patient and the Radium - usually in Platinum needles - is evenly distributed over the outer surface. Sorbo-rubber has now to a large extent replaced Columbia Paste as it possesses all the qualities of the latter and has the advantage of lightness.

A carefully made surface applicator with the Radium accurately distributed, provides a good uniform surface dose, but the intensity of radiation is insufficient to penetrate deeper than one or two centimetres below the skin, therefore its use is restricted to surface growths.

The margin between the general destruction of tissue and the selective destruction of malignant cells is very small, so it is necessary for each area of the tumour to receive equal irradiation. If the dose is too small there is always the danger of survival of malignant cells, and on the other hand if too large a dose is given, there is the danger of destroying healthy tissue. In dealing with this point, The Radium Technical Committee of the Royal College of Physicians and Royal College of Surgeons reported as follows, "--------- whatsoever method has been adopted, its clinical success has always been proportional to the accuracy with which this physical problem has been solved, and there are strong grounds for believing that upon its more complete solution may depend the whole future of Radium Therapy in the

treatment of Cancer. (7).

By increasing the Radium - skin distance, a greater relative depth dose can be obtained, but the maximum tumour dose must always be limited by the threshold of skin tolerance.

To get high relative depth intensity, it is necessary to employ only the hard (short wave-length) gamma rays, since the soft gamma rays are absorbed almost wholly by the superficial tissues. By employing heavy screenage on the Radium, it is possible to eliminate these soft rays and allow only the hard rays to reach the skin. Too heavy screenage, however, is uneconomical because there is insufficient intensity left in the beam. The optimum screenage is about 1.0 m.m. of Platinum. (8)

Several attempts have been made to attain a high depth intensity by using massive Radium units at a distance from the skin, but the work has always been restricted by the cost of the large quantity of Radium and accessory apparatus. I believe such an attempt was made in America during the World War, and the machine was called a "bomb" because of its resemblance to the bombs used in warfare. I can find no definite record of this in the literature however.

Paris Bomb.

Regaud in Paris began in 1924 to experiment with large masses of Radium. His best results were obtained with 4 grammes in a Lead cupola with walls 6 cms. thick and an internal area of 150 sq. cms. To obtain the greatest possible uniformity of the field, he had the Radium in 80 Platinum tubes (each with 1.0 mm. walls) arranged in four groups of 20; one group

placed at each corner of the box. The open side of the box was covered with a block of paraffin wax so that when applied, the plane of the Radium tubes was always at a distance of 10 cms. from the patient's skin. Also, by this combination of filters only the hard gamma rays were allowed to pass. The lead cupola was, of course, very heavy and had to be counterbalanced on a frame to permit of its movement. The unit has been used almost entirely as an accessory to the local treatment of Carcinoma of the Cervix Uteri. (9)

Villejuif Bomb.

This apparatus was designed by Madame Simon Laborde in 1929 for 1 gramme of Radium, but was subsequently adapted to take a second gramme. The Radium is placed at the circumference of a central lead spindle which can be rotated through 180° in a large spherical lead block. In one position the Radium is brought into such a situation that its rays emerge through a window cut in the outer sphere; when the spindle is rotated, however, the Radium is completely screened by lead in all directions. The window is provided with obturators in order that the emergent beam can be made of convenient size. A wooden disc 2 cms. thick is employed to stop secondary beta rays, and the total Radium - skin distance is 12.5 cms. This machine is also counterpoised on a frame and also, like Regaud's equipment, is restricted in its use to the accessory treatment of Cancer of the Cervix. (10)

Radiumhemmet Bomb.

Teleradium treatment was first introduced into the Radiumhemmet in Stockholm by Berven in 1921, since when various units have been in use. The present apparatus is complicated and is constructed in the form of the

letter J. It really comprises two radiation bombs; the larger with a square aperture (7 x 7 cms.), and the smaller with a circular aperture (5 cms. diameter). The whole is pivoted about its central axis so that either bomb may be brought into use at will. The Radium is mounted in a specially designed holder, which, by means of a long key can be moved and locked alternatively in either of the two radiation bombs. In both cases the mean distance between the Radium and the skin is about 6 cms. The complete apparatus is vertically suspended from two iron girders, and can be raised or lowered, and rotated about a vertical shaft. The unit at present contains 3 grammes of Radium, and is used mostly in the treatment of mouth and pharyngeal cancers. (11)

Other Bombs.

Mayer and Cheval of Brussels used 4 grammes of Radium in a bomb at a Radium - skin distance of 12 cms. The main feature of their apparatus was the fact that it was designed to treat two patients at once; one above, and another below the Radium. The practice was theoretically economical, but proved to be impracticable because of the difficulty of making accurate adjustments to both patients. This Radium was later transferred to Westminster Hospital. (12)

Sluys of Brussels used just over 1 gramme of Radium in a unique apparatus; his working distance being 8 cms. The Radium was divided up into 13 portions, and one placed in each of 13 "cannon". The advantage claimed was that there was no need to change the ports of entry on the skin. Each separate unit was carefully adjusted to direct its beam on to the tumour.

The time required to accomplish this, however, rendered the apparatus dangerous to the operator since he was unduly exposed to the radiation. (13)

In America, several "Radium Packs" are in use, notably that designed by Failla at the Memorial Hospital, New York. (14)

Bomb Used in Treating the Cases Described in this Thesis.

This bomb is the fifth one to be employed in this hospital. The first of these, and I believe the first in Britain, was constructed in 1929. It was similar in specification to the Paris unit, but contained only 1 gramme of Radium. (15)

This was superceded a year later by a new model to incorporate 4 grammes. One gramme was placed in each of 4 tubes radially opposed in a flat circular lead block with a variable central annulus. During treatment the tubes were advanced towards the centre so that they projected into the annulus, and when not in use and during adjustment of the patients, they could be withdrawn into the lead. Two patients could be treated at once by this machine; two movable stretchers being provided, one above and one below the bomb. (16)

This design was improved upon. The Radium was divided up into 20 units, and withdrawal into the lead effected by means of a Bowden wire so that the operator had no need to approach the actual bomb. Improvements were also made in the treatment stretchers in the hope of gaining greater accuracy in the apposition of bomb and patients. Each stretcher was supported by a beam from a central pillar, and was made adjustable for height and lateral tilt. These movements were necessary since the bomb was stationary and could

only be rotated round a horizontal axis.

The fourth model contained only 1 gramme, and was much smaller and lighter. It was pear-shaped and was provided with a single aperture - no further attempt was made to treat two patients simultaneously. The cupola was mounted on a wheeled stand and counter-balanced on beams with lead weights, so that it could easily be placed, and would remain in any position. All adjustments were made from the distant end of the supporting beam - 5 feet from the source of activity. By this time, the advantages of a narrow beam of rays were recognised, and instead of providing a variable field as in previous bombs, the field was fixed and small, but the distance from the Radium to the mouth of the bomb could be altered.

This was the first attempt to "apply the bomb to the patient" rather than "apply the patient to the bomb" as had been the custom previously. There were still two great faults however:

(a) The time taken in the application was too great for the safety of the operator.

(b) Allowances for the comfort and movements of the patient during treatment made strict accuracy of orientation and distance impossible.

When a second gramme of Radium became available in 1933, the present unit was constructed. Its main features are as follows:

(a) It is pear-shaped with an external diameter of 14 cms., and weighs only 38 lbs.

(b) The emergent beam is narrow - the aperture being only 35 mm. in diameter.

(c) The nose of the bomb is made entirely of gold. This metal is much more absorbent of gamma rays than lead, hence the nose can be kept to small dimensions without reducing the protection afforded to the surrounding tissues. Scatter of the rays is almost entirely eliminated - the gold at the aperture being 1 cm. thick.

(d) The Radium - skin distance is variable, by means of a push-rod, between zero and 5 cms.

(e) The Radium - skin distance cannot alter, once fixed, no matter how much the patient may move during treatment. A copper cup is strapped on to the patient before he enters the treatment room. (Copper is used as it gives rise to a minimum of secondary beta radiations (17)). This cup fits exactly over the nose of the bomb, to which it can be attached instantly by two metal rings.

(f) The risk of undue exposure of the attendant to gamma rays is reduced to a minimum.

(g) The bomb is freely movable in all directions. It is suspended through a system of universal joints and balanced by a counter-weight over frictionless pulleys attached to the ceiling. A suspension of this type was hitherto untried in Teletherapy.

(h) A lead box is provided on the floor vertically below, into which the bomb can be lowered when not in use.

PATHOLOGY

Before proceeding to discuss the effect of Irradiation, it is essential to review briefly the development and features of the disease on which that effect will be produced.

Nature of Malignancy.

It is not necessary for our present purpose to consider in detail the nature of the etiology of malignancy. Many theories have been propounded within recent times, but in each of these the author admits the possible existence of another factor or factors for which the theory does not allow. In any case, a theory must not be regarded as an attempt to explain a phenomenon but rather as a guiding principle to further research.

The mass of evidence accumulated in the literature would seem to discredit the action of a single factor such as chronic irritation, embryonic cell-rests etc., and favour rather the combination of several agencies either working together or subsequently.

Origin of Cancer.

Sampson Handley (1) has shown very definitely that local lymph-stasis is "a constant precursory factor in malignant disease". This lymph-stasis causes active prolifer ation of the connective tissue cells and of the lymphatic endothelium in the affected area. The fibrous tissue swells and hypertrophies, and on the surface of the skin papillomata are produced. Handley maintains that the proliferation of the epithelium is a late event and secondary to these changes.

as the explanation of the occurrence of distant bony metastases.

Spread of Cancer.

This may take place by local infiltration or by lymphatic or blood invasion.

Local Infiltration.

Immediately a carcinomatous process has become established, the cells multiply by active division and grow into the adjoining tissue in all directions, so that what was recently a healthy structure becomes infiltrated with cancer cells and replaced by fibrous tissue. In this manner the disease extends its margins regardless of any control.

Lymphatic Invasion.

Growth from the primary site takes place along the lymphatic vessels in all directions independently of the direction of lymph-flow. Sooner or later the cells rupture the vessel walls and liberate themselves in the surrounding tissue, in which a characteristic reaction is set up. This is marked by the de velopment of fibroblasts and the laying down of fibrous tissue in an attempt to strangle the growth. The advancing edge of the cancer in the lymphatics is, however, ahead of the fibrosis, so the disease is always free to spread in spite of this natural restraining effort on the part of the host.

Cancer cells may come adrift in the lymph stream and be carried along the vessel as emboli to form deposits in the lymph glands. Souttar (2) is of the opinion that this mode of spread is rare in carcinoma.

Blood Invasion.

This is definitely uncommon in carcinoma although it has been

given as the explanation of the occurrence of distant bony metastases.

Effect of Radium on Cancer.

Generally , cancerous tissue is affected by Radium more readily than normal tissue; and the more rapidly the tumour grows the more sensitive it is to irradiation. This probably results from the fact that the cancer cell is in a state of unstable metabolism and undergoes frequent mitosis. The significance of this will be shown later.

Early observers were of the opinion that the disappearance of growths exposed to Radium, was due to the direct effect of the radiation on the tumour cells, but further investigation sh owed that the adjacent tissues also played a part.

Souttar (3) ascribes the ultimate disappearance of tumour cells to three factors:

1. The direct effect on the cells.
2. The effect on the blood vessels.
3. The invasion of the area by macrophage cells.

Cade's observations (4) are of an almost similar nature.

I have attempted to classify the changes produced by irradiation as follows, and shall endeavour to describe them under these headings.

1. The effect on the tumour.
   - (i) The cancer cell.
   - (ii) The stroma.
   - (iii) Immunity.

2. The effect on the patient.

(i) The skin.

(ii) The blood.

(iii) General.

The Effect of Radium on the Tumour.

(i) The Cell.

Much of the experimental work on the reaction of cells to radiation has been carried out on animal and human tissues which frequently have been non-malignant, so that the results obtained are open to criticism when applied to cancer cells, since it is well known that the metabolism of the cancer cell differs materially from that of the normal adult tissue cell.

The most vulnerable period in the cell's life-history with regard to gamma rays, is during the process of mitotic division. This has now been definitely established. At this time, the cell is in a state of temporary instability and is consequently less able to resist the effects of the rays.

Regaud (5) has attributed these effects to toxic substances produced in the plasma, hence in his view the rays act indirectly on the cells. In the light of more recent evidence, however, it would seem that the changes are due to the ionising effect of the rays on the cell protoplasm (6). The toxic substances are probably derived from the broken-down cells.

The apparently selective action of Radium on malignant cells is due to their frequent and repeated divisions, much in excess of the surrounding normal tissue cells.

The nuclear chromosomes become irregular, the chromatin fragments

and is absorbed by the cytoplasm. The translucent cytoplasm becomes turbid and then finely granular, the limiting membrane is involved, the cell loses its outline and the whole is finally absorbed by the connective tissues. These changes are, of course, produced only by intense radiation, but similar damage although in a less marked degree follows sublethal doses. If the dose is small the cells may recover completely, or the apparent recovery may be followed by atypical mitosis and death of the cell supervene after one or more abnormal divisions.

The morphological changes seen, are undoubtedly secondary to the biological changes. Packard (7) gives these as follows:

(a) Changes in the hydrogen-ion concentration of protoplasm.

(b) Changes in the permeability of the cell membrane.

(c) Changes in viscosity.

(d) Changes in the respiratory rate.

Colwell's investigations (8) substantiate these claims.

Since all the cells in a tumour do not undergo mitosis simultaneously it is obviously necessary to irradiate the tumour several times in order to attack each cell as it reaches the dividing state. The work of Spear (9) bears this out and shows the advantage of repeated small doses of Radium over a single large application.

(ii) The Stroma.

The most obvious stroma changes are seen in the vessels and in the phagocytic invasion of the area.

The Vessels.

Carcinomatous tissue requires for its survival an abundant blood

supply, since it utilises only a small proportion of the energy available. (Instead of glucose metabolism proceeding to the formation of CO_2 and H_2O, it terminates in the formation of lactic acid).

Wilson (10) in his observations on the effect of gamma radiations on the developing chick embryo, noted that after a lethal exposure, the blood-vessels of the "area pellucida" were completely destroyed, and that after an exposure just sub-lethal, the plexus of blood-vessels im the irradiated embryos was much more sparse than in the controls. The smaller vessels had degenerated while the larger ones were still intact. In general, the irradiated embryos were less well developed than the controls.

The primary effect on the vessels is a temporary dilatation; probably due to a transient paralysis of the contractile cells of Rouget (11). Prolonged irradiation may render this permanent.

The primary dilatation is followed by a sclerosis of the vessels which often goes on to complete obliteration. Hocking (12) states that this sclerosis is analogous to the sclerosis achieved by irradiated ergosterol in the excessive vascularisation of Rachitic tissues.

Colwell (13) while stressing the importance of the vascular reaction, mentions that the vascular endothelium and probably also the subendothelial tissue are highly senstive to irradiation. The subsequent constriction of the vessel and the resultant anoxaemic state produced on the cancer cell may, he says, have an effect on mitosis.

The Phagocytic Invasion.

From histological examination of irradiated tumours it would

seem that radiation stimulates the cellular invasion of the area - chiefly the macrophage cells. Large numbers of fibroblasts also make their appearance, and an intense reaction takes place round the malignant cells; the object of which is to destroy the disease and replace the tumour by fibrous tissue.

Although this process occurs in untreated cases, as already shown, the cancer cells always grow in advance of the fibrosis. With the additional stimulus of irradiation, however, in certain cases the growth can be checked. Todd (14) has attempted to accentuate the stimulus still further by the injection of a sulphur-selenium compound before irradiation - using X-rays.

(iii) Immunity.

The experimental work of Russ, Chambers and Scott suggests that during the destruction of cancer cells some factor or factors may be produced which inhibit tumour growth. Colwell (15) comments on this work and emphasises the treatment of tumours by small individual foci of highly filtered gamma radiation as offering the best means for the formation of such antibodies.

The Effect of Radium on the Patient.

(i) The Skin.

It must always be realised that the local reaction of the tissues to Radium is determined by several factors ;

(a) The duration of application.

(b) The time intervals between applications.

(c) The Radium-skin distance.

(d) The wave-length of the rays. (Assuming always that sufficient filtration is employed to stop the beta rays).

It has been shown in the previous chapter that the longer wave-length gamma rays are absorbed by the superficial tissues.

If the surface method of treatment is employed, the skin reaction is of earlier onset and more rapid in its development than in Distance Therapy, where it is usual to apply the Radium to several ports of entry in rotation so that the skin may make an effort to recover between each treatment. The heavy screenage on the bomb permits only the short wave-length gamma rays to reach the skin, and only a small proportion of these are absorbed.

We need only consider the reactions produced by Distance Therapy.

The skin surface first presents a hyperaemic appearance. This is of very gradual onset, but is well established by the end of the first week of treatment. Pigmentation follows, and the secretion of the subaceous glands is suppressed; so by the third week the skin is brown and the surface dry and scaly. Epilation occurs and may be complete by this time. Varying degrees of oedema may be met with, but if the patient is carefully observed and treatment discontinued for a day or two, it will frequently disappear. Blisters appear and the superficial layers of the skin separate, leaving a smooth pink moist surface on which forms a yellowish-white film of fibrin.

Treatment must on no account be continued after this stage is reached, or the dermis and blood-vessels will be damaged to such an extent that healing will be prolonged.

Normally such a reaction as described will granulate over in about four weeks with the formation of healthy skin. In a few cases teleangiectasis may be seen over a healed area.

Great care must be taken, however, not to expose a previously irradiated surface to slight injury, as even years afterwards it may again break down; the blood-vessels having been slightly but permanently damaged at the time of treatment.

(ii) The Blood.

There has been much diversity of opinion among pathologists regarding the effect of radiation on the blood.

From my own experience of weekly blood-counts on several hundred patients undergoing Radium treatment, it would appear that in the majority of cases there is a diminution in the number of red and white cells per cubic millimetre. Both neutrophil leucocytes and lymphocytes seem to be reduced in numbers, and in several cases there appeared to be an increase in monocytes, and occasionallly in eosinophil leucocytes. In these latter cells there is very often signs of degeneration; the nucleus being atypical. The structure of the normal eosinopil cell is, of course, known to be of a delicate nature.

It was extremely difficult to arrive at any more definite conclusions as so many adventitious factors must be taken into account, as for example, co-existing septic processes and patients' idiosyncrasies in their reactions to the liver and iron therapy which was in most cases carried out during treatment.

In a series of experiments in which granulocytes (neutrophil leucocytes) were bombarded with gamma rays, Wallgren (16) was able to show that the first demonstrable biological effect of irradiation was the immobilisation of the granulocytes, while structural changes did not become evident until later.

(iii) General Reactions.

Distance Therapy seems to upset the general metabolism to a smaller extent even than surface therapy. In the former case the constitutional effects that have been found after irradiating large surfaces are reduced to a minimum, because while the radiation beam is of high intensity, the area of absorption of the rays is limited. In the case of Distance Therapy also, treatment is more gradual, hence there is less endogenous intoxication from the rapid breaking down and absorption of tumour cells.

The symptoms consist of general depression, anorexia and malaise. Extreme degrees of shock with vomiting and collapse such as follow intense X-ray treatment are very rare.

The ultimate aim in all Radium therapy must be therefore,

(a) To attempt to destroy the cancer cells.

(b) To stimulate the natural defensive mechanism of the patient.

(c) To minimise the damage to healthy tissues.

The Pathology of the Tumours Treated.

The diagnosis of these tumours, with a few exceptions, is based on clinical observations. Biopsies were not carried out before treatment, as the possibility of hastening the dissemination of the disease by surgical interference with the substance of the tumour was well recognised. A knowledge of the minute histology was not considered sufficiently urgent to warrant the risk of a biopsy. The exceptions to this rule were those cases in which surgical removal had been attempted on some previous occasion.

Bloodgood (17) believes however, that the dangers of a biopsy can be reduced greatly by a course of preliminary irradiation.

Carcinoma of the Tongue.

Carcinoma of the Tongue is much more common in men than in women : 80% of the cases I have met with occurred in males.

Histology.

The growth begins in the squamous epithelium covering the tongue and grows down in columns to infiltrate the muscular layer, giving rise to well-marked cell-nests. The histological appearances vary according to the site of the lesion.

In the anterior part of the tongue the squamous-celled structure tends to be well preserved, and the occurrence of metastases is less frequent than in tumours of the posterior part where the cell-nests are a less prominent feature and the a ppearances may even resemble a basal-celled epithelioma. In this case the malignancy is af a higher order and the possibility of early metastases is much greater. All intermediate stages may be found in the intervening portions of the organ.

The middle third is by far the most common site. The cancer usually originates at the margin and spreads to involve a large portion of the tongue. The rapid proliferation of connective tissue gives rise to the induration and fixation so frequently found accompanying the disease.

Clinical Features.

There are three types of growth.

The Ulcerative type is very common. It often develops from what is to all appearances a simple ulcer caused by a ragged tooth or some such irritation factor. The ulcer has hard indurated edges, bleeds readily, and may spread to destroy a considerable area of the tongue, floor of the mouth, fauces and tonsils. In the late stages, this type, in particular, gives rise to intense pain and dysphagia.

The Infiltrating type forms as a tumour within the tongue, causing slight limitation of movement, and is characterised by the early development of metastases.

The Fungating type is sometimes associated with pre-existing leukoplakia, and the first sign of the growth may be a small papilloma which frequently persists for a considerable time before any induration or ulceration is detectable.

Metastases.

Metastases in the neck are a very common feature of carcinoma of the tongue; although spread beyond this region is but rarely seen.

The lymphatic system of the tongue includes the chain of cervical glands along the great vessels in each side of the neck, the submaxillary, the submental and the supra-hyoid glands; hence in advanced cases practically the whole neck may become involved in an extensive fixed mass. In the early stages, the submental glands are usually involved by growths of the tip of the tongue, the submaxillary by growths of the lateral

margins, and the deep cervical group by growths of the posterior third. Bilateral metastases may result from single primary growths because of the bilateral lymph drainage in the centre of the tongue.

Response to Radium.

The tumour's response to radium depends on

(a) Type of Growth. Those types considered most malignant from a surgical point of view (i.e. cellular and rapidly growing) seem to offer the best response.

(b) Degree of Oedema and Infection. It is essential, before commencing treatment, to eradicate all septic foci in the mouth by extracting carious teeth etc., since radiation causes the infection to flare up, resulting in massive necrosis and sloughing of tissue. The presence of oedema may lead to similar effects, and if it occurs at the base of the tongue it may give rise to obstruction and endanger the life of the patient.

Primary cancer of the tongue reacts exceedingly well to interstitial radium but the glandular metastases have resisted all forms of treatment except surgical excision and distance therapy. Hence it is with the metastases that we are concerned in this thesis.

Carcinoma of the Buccal Mucosa.

Carcinoma may arise from the mucosa of the mouth in any situation - floor of the mouth, alveolar margin, cheek, palate, fauces or tonsil. Frequently the ulcer is extensive and involves two or more of these regions or even erodes the underlying bone.

The growth is squamous-celled as in the case of the tongue, and metastasizes readily into the submental, submaxillary and deep cervical glands.

The primary lesions with the exception of those of tonsillar origin, respond well to interstitial or surface radiation but the metastases are again very resistant to these methods.

Carcinoma of the Upper Air Passages.

These are all squamous-celled carcinomata.

Tumours of this region are usually described as Pharyngeal and Laryngeal; the latter being subdivided into Intrinsic and Extrinsic, depending on their site or origin. For the consideration of their response to radium, this classification seems to be inadequate, therefore I propose to deal with the whole group under the following headings, as these cover all the tumours described in the thesis:-

1. Endolaryngeal Carcinoma.
2. Carcinoma of the Sinus Pyriformis.
3. Carcinoma of the Vallecula.
4. Carcinoma of the Post-Cricoid Region.

Endolaryngeal Carcinoma.

In this class we need only consider the growth arising from the vocal cords. The right cord is affected with much greater frequency than the left, and the subjects are usually males. The tumour is of the pavement-epithelium type and is of relatively low malignancy. It does not commonly give rise to glandular involvement until it is far advanced or has spread to other structures. The results of treatment - whether consisting of surgical

excision or combined surgery and radium (Fenestration Operation (18)) - are gratifying, but the radium bomb provides a method that is least disturbing to the patient.

Carcinoma of the Sinus Pyriformis.

These are almost always inoperable and are characterised by early dissemination: in fact, the first clinical sign is often the appearance of a mass in the neck. The primary may become extensive and involve a large part of the Arytenoids and Epiglottis. Response to treatment is generally poor and even if temporary regression takes place the disease nearly always recurs.

Carcinoma of the Vallecula.

The growth may be of a fungating or ulcerative variety and in a high percentage of cases is infected. It readily infiltrates the Arytenoids, Epiglottis and Base of the Tongue, and lymphatic spread is early. Treatment is unsatisfactory.

Carcinoma of the Post-Cricoid Region.

These are highly malignant and rapidly disseminating tumours. They spread over the pharyngeal wall and are difficult of access. Palliation is usually all that can be achieved by treatment.

Carcinoma of the Breast.

This condition accounts for about one third of all the cancer occurring in women.

Histology.

It usually arises in the acini or small ducts of the gland and is

in most instances a spheroidal-celled carcinoma. The nodule is composed partly of growing and dividing cells and partly of fibrous tissue. This fibrous stroma which is usually present in excess of the cellular element, gives to the tumour a firm or even hard quality which is typical of the average breast carcinoma or "Scirrhus". All degrees may be found, however, depending on the proportion of cells to stroma. Very hard or very soft cancers are met with, but by far the most common is an intermediate type.

Scirrhous Carcinoma. The cells may preserve their glandular arrangement or they may grow in a haphazard fashion throughout the fibrous tissue, but growth is slow on account of the resistance offered by the stroma. Metastases as a rule, do not form in the early stages.

Atrophic Scirrhus occurs in old women. Proliferation of cells takes place very slowly indeed and the nodule is stony-hard, consisting as it does almost entirely of stroma with only a few scattered cells. It rarely gives rise to secondary deposits.

Encephaloid Carcinoma. This form occurs chiefly in young women. It is very cellular in structure and rapidly grows into a large soft tumour which very soon involves the lymphatics. Carcinoma occurring in a breast during pregnancy or lactation is of this type , and in the latter instance the breast almost invariably becomes infected and the condition develops into the "Acute Carcinoma" which spreads with amazing rapidity.

The cases dealt with in the thesis are all of the scirrhous variety.

Clinical Features.

It is exceptional to find an early carcinoma of breast giving rise to pain. Examination reveals a hard irregular tumour in the substance of the breast which is not tender on pressure. The Axillary quadrant is the most common site, and when cancer does arise in other areas the prognosis is not so hopeful. At first the lump is movable with the breast tissue over the deep fascia on the Pectoralis Major muscle; later it becomes adherent to the overlying skin by retration of the interlobar septa, and is anchored to the deep fascia, so that the surrounding breast is a fixed mass. Later still, if untreated, it forms attachment to the chest wall, by which time large secondary deposits have usually developed. As fibrosis proceeds the breast becomes shrunken and in the classical case the nipple is retracted and elevated by the contraction of the connective tissues. In advanced cases infiltration of the skin may lead to ulceration and subsequent infection, resulting in a large foul sloughing mass.

Metastases.

The lymphatic drainage of the breast comprises an intricate system of interconnecting channels extending over a wide area on the chest wall and trunk. A clear understanding of its anatomy is essential to the satisfactory treatment of cancer, no matter what method is to be employed.

There are perilobar, periductal and interlobar channels which drain into the Pectoral Lymphatic Plexus lying on the deep fascia over Pectoralis Major. Lying under the areola is the Sub-areolar Plexus which

is a particularly rich system of small vessels, linked up to a subcutaneous network spread over the surface of the breast. Invasion of this latter network gives rise to the clinical condition of "Cancer en cuirasse".

The majority of lymph vessels pass from the breast to the pectoral glands, situated along the anterior border of the axilla behind the edge of Pectoralis Major. These are connected with the central axillary set on the inner side of the axillary vein, and both groups are linked up with the deep axillary glands lying in front of the axillary vessels. These become continuous with the deep cervical glands.

A few vessels from the medial aspect of the breast drain into the anterior intercostal glands, while others lead downwards to join the extra-peritoneal lymphatic system.

Inter-communication takes place between opposite sides of the body and with the intra-thoracic lymphatics, hence it is not uncommon to find secondary deposits in the lungs.

Post-operative recurrences usually take the form of cutaneous nodules in the vicinity of the scar, or of glandular metastases in the supra-clavicular region.

Response to Radium.

Generally, cancer of the Breast reacts well to Radium. The primary tumour and the secondary deposits can frequently be made to disappear entirely, or short of this, an area of inactive fibrosis may remain. Recurrence of the disease is common, however, and the patient must be kept under close observation over a long period of time.

THE TECHNIQUE OF TREATMENT

Up to the present time no standard routine technique for the administration of Teleradium Therapy has been adopted. The various centres at which bomb units are in use have each elaborated their own methods, suited to the requirements of their appliances and to the type of cancer to be treated; adapting them from time to time as experience is gained.

Carling (1) has observed recently that the problems of the Radium Teletherapist are those of the Deep X-ray Therapist; for their solution there is really only one method available, that of trial and error.

The protection of the personnel is the prime consideration in Distance Therapy otherwise disaster is inevitable, and arrangements for the manipulation of the bomb must always be calculated to assure the immunity of the operator from either direct or stray gamma radiations. This matter, however, is dealt with later in the chapter.

Details of Bomb.

As was shown earlier, the bomb used in this present work consists of a solid Lead sphere 14 cm. in diameter, through which runs a vertical circular canal in which the Radium container may be moved in the manner of a piston by means of a long push-rod projecting from the upper pole of the bomb and graduated in a 0.5 cm. scale. The readings on this scale indicate the distance between the focal point of the active Radium source and the plane of the aperture of the bomb.

The 2 grammes of Radium are in the form of Radium Sulphate which is packed in nine tubes of Monel metal, and arranged in an Aluminium container situated at the lower end of the push-rod. The total screenage, made up of 0.3 mm. Monel metal and 6.0 mm. Aluminium, is approximately equivalent to 1.0 mm. Platinum which is sufficient to arrest almost entirely the beta and soft gamma rays.

At the lower pole of the bomb the Lead sphere merges into a narrow neck fashioned from solid gold, so that the whole structure in shape represents an inverted pear. The use of Gold for the nose-piece allows the dimensions to be reduced to a minimum, thereby facilitating its application to restricted areas such as the neck, and at the same time provides adequate screenage to prevent lateral scatter of the rays.

The bomb is mounted in a metal "horse-shoe" which is in turn suspended by a wire cable running in two overhead pulleys, and attached to a weight with which the bomb is counterpoised. The "horse-shoe" is and the Bomb in the "horse-shoe" through a horizontal axis, pivoted on the wire about a vertical axis, so that the emergent beam may be turned freely in any direction. Since these pivots are taken through the centre of gravity, the apparatus will remain stable in any situation.

A sliding ring carrying two small hooks encircles the bomb just above its nose and this affords attachment for a Copper cup which is interposed between bomb and patient. The significance of the Copper cup may be explained at this stage. These were designed as a means of attaching the bomb to the patient while at the same time allowing a certain freedom of movement such as might be expected of a patient remaining in a stationary

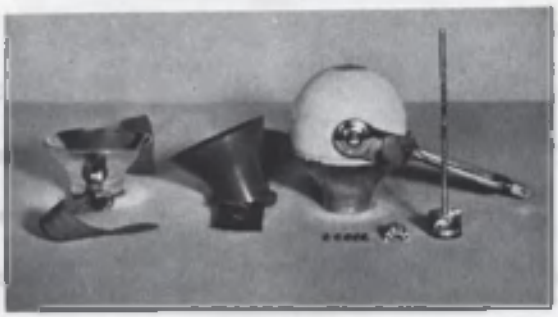

FIG. 1. Showing two types of Copper Cup with dismantled Bomb and Radium container.

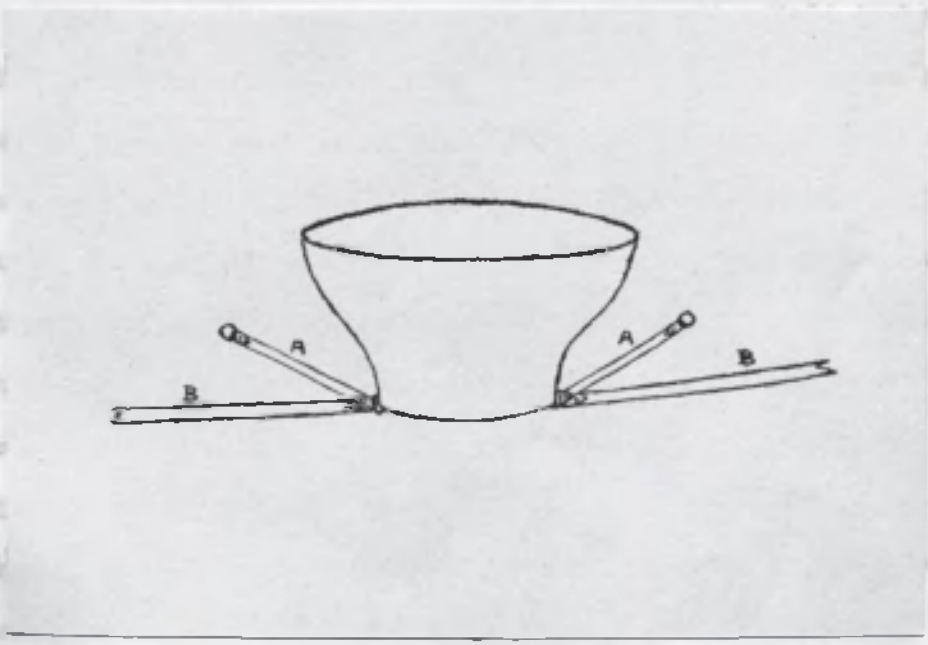

FIG. 2. Diagrammatic representation of Copper Cup with (A) rubber straps and rings for attachment to Bomb, and (B) rubber straps for attachment to patient.

attitude for an hour. It is imperative that whatever movements do take place, the Radium-skin distance must remain accurate. The cup, of 0.5 mm. Copper, is made to fit exactly over the nose of the bomb, and to its base is affixed a rubber strap; two rings also being provided to engage the hooks on the bomb. (See Fig. 2) The base of the cup rests on the skin and is held by the rubber strap.

The application of the bomb is perfectly straightforward when, as is the case in Fig. 3, the field of application lies directly over the tumour.

Difficulties arise however, when the field to be dealt with lies outside the area superficial to the tumour, as will frequently occur when pursuing the cross-fire scheme. To overcome these, a series of angled cups are employed, fitted with oblique bases, so that when the base is in contact with the skin the bomb is held at the correct angle to irradiate the growth. Using cups of varied angles it is possible to spread treatment over a skin area much wider than the extent of the tumour and still be certain that the radiation beam passes through the growth. This policy enables us to carry out a cross-fire bombardment with convenience: cups of increasing angulation being employed for the areas more remote from the tumour margin.

Ports of Entry.

The position and extent of the treatment surface is defined by clinical and if practicable, radiological evidence of the situation and size of the tumour, and to assure accuracy of application in subsequent

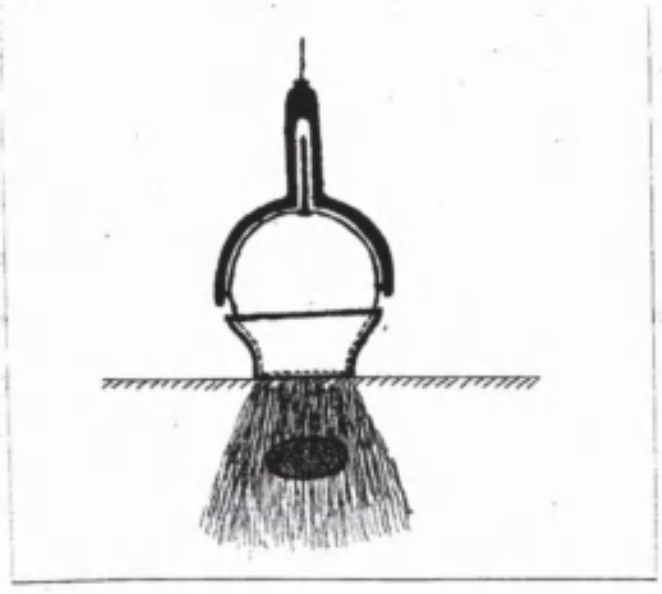

FIG. 3. Ordinary cup in use for direct irradiation of tumour.

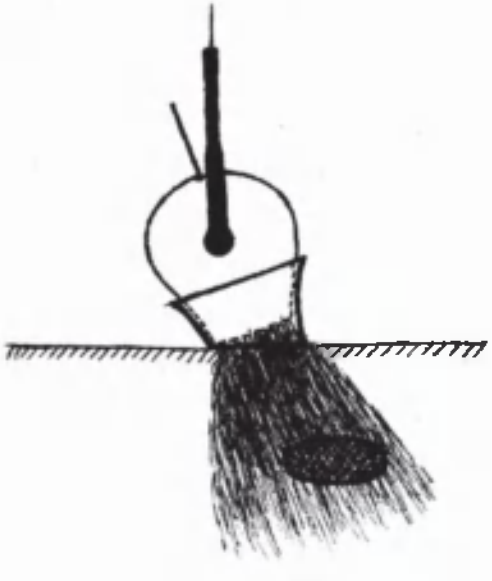

FIG. 4. Angled cup in use for "cross-fire" irradiation of tumour.

treatments the skin is actually marked off in a series of numbered fields (Ports of Entry). (Fig. 5) The fields usually vary in number from 4 to 6 and are painted on the skin with Finzi's Ink. This pigment was chosen and indeed was first compounded because it gives rise to a minimal secondary beta radiation by virtue of its low content of elements of high atomic number. The formula for Finzi's Ink (supplied by Allen & Hanburys Ltd.) is as follows:

Ac. Pyrogallic	1 gramme
Liq. Ferri Perchlor.	2 c.c.
Alcohol	10 c.c.
Acetone	20 c.c.

The ink, when dry, does not easily rub off and will remain visible even in the presence of a good deal of sweating. In practice, however, after 3 or 4 hours' irradiation the sweat glands become almost inactive and the markings are clearly discernable on the dry epithelial surface after several days. If, during the course of treatment, it is thought advisable to alter the fields with a view to obtaining a more homogenious depth dose, this can easily be accomplished by washing the skin with acetone before painting on the new fields. A record of the ports of entry, in the form of a "life-size" tracing on transparent paper, is kept in each case from the commencement of treatment, so that if the original is rubbed off by accident it can quickly and accurately be replaced.

Accessory Apparatus.

This consists of an adjustable couch on which the patient

FIG. 5. "Ports of Entry" marked on skin with Finzi's Ink, as used in the treatment of Carcinoma of the Pyriform Fossa. N.B. Treatment area has not been shaved.

reclines comfortably during treatment. He is supported on a sheet of thick canvas stretched on a rigid wooden frame which can be pivoted around a fixed pillar secured to the floor. The couch, therefore, is capable of a floating movement across the floor of the treatment-room, enabling the affected region of the body to be placed directly beneath the suspended bomb. A bell-push is incorported on the edge of the couch to summon the attendant from an ante-room.

In order to screen the Radium completely while it is not in use or while changing over patients, a Lead container is situated on the floor, into which the bomb can be lowered.

A room is set aside to house the entire Radium unit and is reserved solely for this purpose.

Preliminary Preparation of Patients.

When a patient was presented for treatment he was given a careful general clinical examination. A complete Blood Count was carried out to ascertain whether he could be expected to withstand a course of treatment without the danger of severe anaemia supervening. I am of the opinion, however, that severe blood destruction is very rare with therapeutic doses of Radium. As is mentioned in an earlier chapter, all obvious septic foci were dealt with, special attention being paid to any foci adjacent to the site of the lesion. As a rule, only when the patient was apyrexial was he subjected to Teletherapy. This was the ideal aimed at, but in practice no one for whom there were prospects of improvement was denied treatment.

FIG. 6. Patient undergoing treatment with Bomb attached to neck. The Bomb follows the movements of the patient.

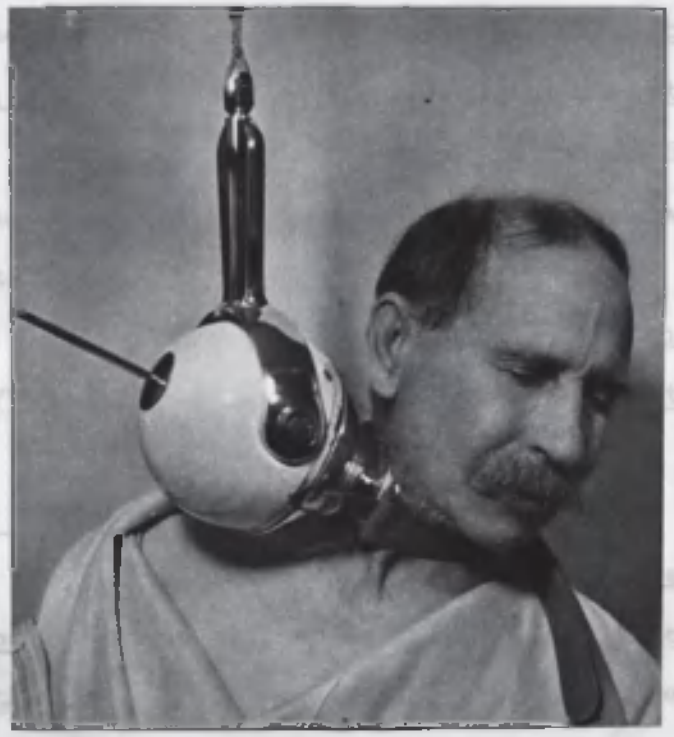

FIG. 7. Showing details of attachment.

Detailed Technique of Application.

Before entering the "Bomb Room" a copper cup, of appropriate angle, was strapped to the patient over the particular port of entry due to be treated. On entering the room he took up his position on the couch: the bomb in the meantime being housed in its receiver on the floor. The bomb was now raised by pulling on the counter-weight, and the couch swung into position beneath it, so that the bomb nose-piece could be lowered into the cup. All that remained, was for the attendant to attach the cup rings to the hooks on the bomb by means of a special wooden rod, and to adjust the Radium-skin distance. (Figs. 9 & 10) The whole procedure occupied less than one minute, after which the attendant retired to an ante-room.

At the end of treatment the reverse procedure took place: the bomb was unhooked and raised, the couch swung sideways, and the bomb lowered into its housing.

The attendant was thus exposed to the radiation in the vicinity of the bomb for only about two minutes per patient.

Control of Treatment.

An attempt was made in all cases to deliver the maximum possible dose of radiation to the tumour without inflicting any permanent damage on the skin. The limit, beyond which skin recovery will not take place, was described in the previous chapter, and when this reaction was

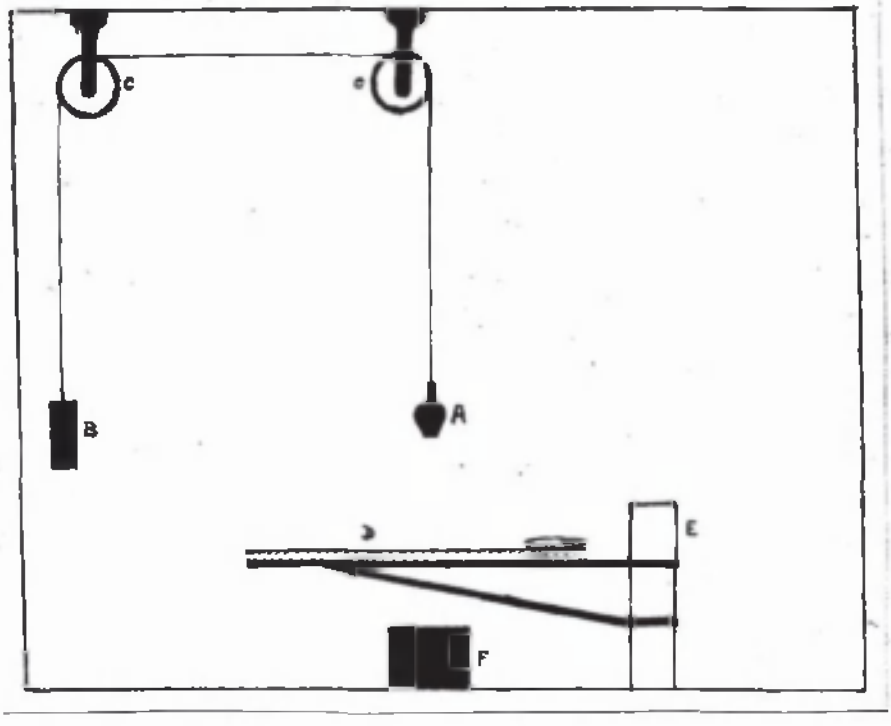

FIG. 8. Diagram showing arrangement of Treatment Room.

A. Bomb.
B. Counter-weight.
C. Pulleys attached to ceiling.
D. Couch.
E. Supporting pillar on which couch is pivoted.
F. Lead receiver for Bomb.

obtained treatment was discontinued: the dosage was based on the skin tolerance.

Attempts to increase this tolerance factor have, of course, been made. The patient was advised against washing or shaving the treatment area, and in the earlier cases, sterile vaseline on lint was applied to protect the epithelium. It was subsequently discovered, however, that by maintaining the surface in a dry state, larger doses could be administered before the onset of epidermitis, and latterly, all cases received repeated applications of Zinc Stearate dusting powder, which allowed the skin to become a deep brown, discouraging desquamation and preventing vesication.

Management of Patients during Treatment.

Since the treatments are each only of one hour's duration, it is convenient that the patient attends the hospital daily for his application, unless his general condition is such as to prevent him getting about. This relieves considerably the bed congestion in the wards, and ensures that the patient has the benefit of a certain amount of exercise and fresh air daily; both desirable to anyone undergoing treatment.

The bomb in this hospital is in continual use for 24 hours each day, and the customary arrangement is that out-patients receive their treatment during the day, while in-patients are fitted in at night. This practice works very satisfactorily.

FIGS. 9 & 10. Showing stages in the attachment of the Bomb.

General Accessory Treatment.

The patient must continue under close observation throughout the duration of treatment. In the cases described here, Blood Examinations were carried out routinely each week - Haemoglobin, Red Cell, White Cell and Differential Counts were done, and with the exception of a few instances in which the blood state was perfectly satisfactory, all received a course of Liver and Iron therapy. Blood transfusion was but rarely necessary, and was not resorted to in any of the cases described in this thesis.

No special dietetic regime is necessary, and the patient may be allowed to decide for himself in this matter.

"Follow-Up" System.

Patients should continue to be seen at intervals over a period of years after treatment. In the beginning they can attend weekly, but as time passes the examinations may become much less frequent. Only in this way can any really valuable results be obtained, or any recurrence of the disease be treated at an early stage.

Expression of Dosage.

Most workers are now agreed that a universal standard for the measurement of Radium dosage must be based on the ionisation produced by the gamma rays, similar to the international "r" (Roentgen) unit used in Deep X-ray Therapy.

From the recent investigations by Flint and Wilson (2) of the intensity values for the actual bomb used in this thesis, it is possible

to compile the following table:

Radium-skin Distance	3 cm.	5 cm.
Skin Intensity	18.3 r/min.	8.4 r/min.
Skin Dose per Hour	1100 r	504 r
Percentage Depth Dose at 10 cm.	5.8 %	10.1 %
Depth Dose per Hour at 10 cm.	63.8 r	50.9 r

The last two lines demonstrate the relative increase in depth dose obtained by increasing the Radium-skin distance, while, of course, the actual depth dose is diminished.

With this bomb, working at a Radium-skin distance of 3 centimetres, an erythema is produced in 6 hours; hence from the table, the erythema dose is 6,600 r.

For the purpose of simplicity in this thesis, the doses used are expressed in "milligramme-hours". This term is quite inadequate to cover all the factors which may influence skin dosage, but for the cases described, the source of radiation remained constant throughout, and the only variable condition was the Radium-skin distance. This was either 3 cm. or 5 cm., and since the figure is always stated, the "milligramme-hour" can be used as a satisfactory practical unit.

The term, as used here, is, of course, the value: Quantity of Radium (in mgms.) X Time (in hours).

i.e. 2,000 X Total hours of treatment.

At a Radium-skin distance of 3 cm. the erythema time was 6 hours, hence, the erythema dose is

2,000 X 6

i.e. 12,000 mgm. hrs.

Therefore 12,000 mgm. hrs. = 6,600 r.

Hence 1 mgm. hr. = 0.550 r.

In the cases treated at 5 cm., the ratio $\frac{r}{\text{mgm. hrs.}}$ can again be calculated.

It is known that at 5 cm. an erythema is produced in 13 hours, and by substituting this value we find that the erythema dose is

2,000 X 13

i.e. 26,000 mgm. hrs.

Hence 26,000 mgm. hrs. = 6,600 r.

Therefore 1 mgm. hr. = 0.254 r.

It is of interest to note that the actual skin dose per "milligramme-hour" was decreased by approximately 50% as the routine treatment was changed from 3 cm. to 5 cm. Radium-skin distance. This alteration was made in order to increase the percentage depth dose.

Protection of Workers.

Complete protection from gamma rays is technically impossible owing to their great power of penetration, but much can be done to attenuate the intensity of the rays to a degree at which they will produce no appreciable

injury to the worker on even constant exposure. This dose, which can theoretically be absorbed indefinitely without injury is usually referred to as the "Tolerance Dose". Owing to the lack of definite evidence on the subject, this can at present be regarded as little else than a hypothetical threshold, and authorities differ widely as to its absolute value.

The Health Organisation of the League of Nations (3) has reviewed the data at present available, and in its report has assumed that the body is equally susceptible to X-rays and gamma rays. It has accepted as a tolerance dose 0.2 r. over the whole body during a normal working day; that is equivalent to about 10^{-5} r/second. This basis probably allows a great safety factor, and the value does not appear to be reached in any of the departments investigated (4).

Protection of workers may be achieved in three ways :

1. By the employment of heavy screenage on the Radium.
2. By remaining at a distance from the active source.
3. By limiting the time of exposure in proximity to the source.

In most clinics where smaller quantities of Radium are employed, all three methods usually play their part, but chiefly the first. It is necessary when making plaques or threading needles to handle the Radium at close range, but this can be done in thick-walled lead chambers.

In Teletherapy, however, it is impracticable to enclose the Radium in anything approaching adequate screenage, since the weight of the apparatus would render it immobile and cumbersome to the patient. Safety

must depend, therefore, on the two latter factors - distance and time. and the apparatus and technique have been designed with this end in view.

It will have been noticed earlier in the chapter that in the application, it was unnecessary for the attendant to handle the bomb at all, and the exposure per treatment need not be more than two minutes. While the Radium is in use the attendant is accommodated in a separate room, thus providing a great distance factor, and in addition, the intervening wall is coated with Barium plaster. The value of the latter is probably not great, however, for it has been shown that the protective value of solid Barium contrete, relative to lead, is only about one quarter (5).

The operator must be educated to appreciate the dangers involved in careless handling of the apparatus, and taught to regard distance as the greatest safety factor: if it is necessary to approach the bomb, he must do so from such an angle that he does not cross the direct beam.

Only persons enjoying good health should be appointed to the staff, and they must have ample opportunities for exercise and fresh air. Their bleod state should be examined at intervals of a month, so that on the earliest signs of blood changes they can be sent on holiday.

RESULTS.

Cases Treated.

Metastases from Carcinoma of Tongue & Buccal Mucosa	15 cases.
Primary Carcinoma of Upper Air Passages	25 "
(Intrinsic Carcinoma of Larynx ..... 4 cases)	
(Pharyngeal Carcinoma ..... 16 ")	
(Post-Cricoid Carcinoma ..... 5 ")	
Carcinoma of Breast	21 "
(Primary Carcinoma of Breast ..... 8 cases)	
(Metastases from Carcinoma of Breast ... 13 ")	
Total	61 "

The results of treatment in each group are examined separately.

METASTASES FROM CARCINOMA OF TONGUE AND BUCCAL MUCOSA.

Untreated Cases.

According to Bland-Sutton (1) ".... the average duration of life varies from 6 to 24 months from the time cancer is recognised".

Comparison of Results of Radiation Treatment in Carcinoma of Tongue and Buccal Mucosa.

Author	Primary Lesion	Method	No. of Cases	Survival in Years		
				5	3	2
Cade (2)	Tongue	Radium	18	2 (11.1%)	3 (16.6%)	1 (5.5%)
Rose & Phillips (3)	Tongue & B.Mucosa	Radium	192	—	—	76 (39.6%)
Pfahler (4)	Tongue & B.Mucosa	Radium	264	40 (16.6%)	26 (9.8%)	—
Gardner (5)	Tongue	Radium & Xray	21	3 (14.3%)	—	—
Raven (6)	Tongue	Radium	52	—	2 (3.8%)	6 (11.5%)
Berven (7)	Tongue	Radium	186	49 (26.3%)	—	—
Quick (8)	Tongue	Radium	473	39 (8.2%)	24 (5.0%)	24 (5.0%)
Quick (9)	Buccal Mucosa	Radium	572	39 (6.8%)	36 (6.2%)	—

Comparison of Results of Surgical Treatment in Carcinoma of Tongue and Buccal Mucosa

Author	Primary Lesion	No. of Cases	Survival in Years		
			5	3	2
Raven (10)	Tongue	30	11 (36.6%)	6 (20%)	5 (16.6%)
Gask (11)	Tongue	70	12 (17.1%)	—	—
Patterson (12)	Tongue & B.Mucosa	34	9 (25%)	—	—
New (13)	Tongue	156	58 (37.1%)	—	—

Results of Treatment of Metastases in Neek from Carcinoma of

Case No.	Age	Sex	Duration	Primary Lesion	Treatment of Primary Lesion
1	62 yrs.	Male	1 year	Tongue ant. third	Inter. Irrad.
2	67 yrs.	Male	5 months	Tongue mid. third	Inter. Irrad.
3	54 yrs.	Male	15 years	Tongue ant. third	Inter. Irrad.
4	70 yrs.	Male	6 months	Tongue mid. third	Inter. Irrad.
5	74 yrs.	Male	4 years	Tongue post. third	Diathermy Excision
6	81 yrs.	Male	6 months	Tongue ant. third	Nil
7	51 yrs.	Male	2 years	Tongue mid. third	Inter. Irrad.
8	71 yrs.	Male	8 years	Tongue mid. third	Diathermy Excision
9	71 yrs.	Female	7 months	Tongue mid. third	Inter. Irrad.
10	32 yrs.	Female	2 years	Tongue mid. third	Inter. Irrad.
11	50 yrs.	Male	1 year	Floor of Mouth	Diathermy Excision
12	50 yrs.	Male	$2\frac{1}{2}$ years	Floor of Mouth	Nil
13	78 yrs.	Male	2 years	Alveolar Margin	Nil
14	54 yrs.	Male	4 months	Soft Palate	Inter. Irrad.
15	65 yrs.	Male	4 years	Hard Palate	Inter. Irrad.

Tongue and Buccal Mucosa.

Metastases	Immediate Result	Late Result
Right Submental gland	Glands Disappeared	No evidence of Disease - 13 months
Left Submaxillary & Submental glands	No palpable glands	No evidence of disease - 10 months
Both Submaxillary glands	No improvement	Died - 2 months
Left Submaxillary & Submental glands	Glands much smaller	Recurred - 5 months Died - 9 months
Left Submaxillary & Deep Cervical glands	Glands much smaller	Recurred - 7 months
Both Submaxillary glands	No improvement	Died - 4 months
Left Submaxillary gland	Gland small & indurated	Recurred - 8 months Died - 10 months
Left Submaxillary gland	Glands disappeared	Recurred Died - 3 months
Both Submaxillary glands	Glands slightly smaller	Recurred - 5 months
Right Submaxillary gland	Gland much smaller	No evidence of disease - 18 months
Right Submaxillary & Deep Cervical glands	No improvement	Died - 2 months
Right Submaxillary gland	Glands smaller	Disease stationary - 9 months
Right Submaxillary gland	Gland disappeared	No evidence of disease - 14 months
Left Submaxillary & Deep Cervical glands	Glands smaller	Recurred - 7 months
Left Submaxillary gland	Gland much smaller	Died from Pneumonia - 5 months

Analysis of Results

Total no. of cases 15

Two cases were females ..... i.e. 13.3%

All cases showed metastases in the lymphatic glands of the neck.

Treatment of Primary Growth.

Interstitial Irradiation (previously) ..... 9 cases.

Diathermy Excision (previously) ..... 3 "

Teletherapy (concurrently) ..... 3 "

Degree of Improvement.

A. Glands completely disappeared ..... 5 cases (33.3%)

B. Glands present but smaller ..... 7 " (46.6%)

C. Not improved ..... 3 " (20%)

A.

No signs of disease after 18 months ..... 1 case.

" " " " " 14 " ..... 1 "

" " " " " 13 " ..... 1 "

" " " " " 10 " ..... 1 "

" " " " " 3 " ..... 1 "

B.

Disease apparently inactive after 9 months .. 1 case.

" " " " 8 " .. 1 "

" " " " 7 " .. 2 cases.

Disease apparently inactive after 5 months ... 3 cases.

(One of these latter cases died from Pneumonia; no evidence of recurrence of disease when last seen)

C.

No improvement: died from the disease in 4 months ... 1 case

" " " " " " " 2 " ... 2 cases.

(These three cases were all extensive and infiltrating metastatic growths).

Results in Relation to Age.

Average age of cases treated ..... 62 years.

Age Group	No. of Cases	Glands Disappeared	Glands Smaller	Not Improved
Under 50 yrs.	1	1 (100%)	-	-
51 - 60 "	5	-	3 (60%)	2 (40%)
61 - 70 "	3	2 (66.6%)	1 (33.3%)	-
71 - 80 "	5	2 (40%)	3 (60%)	-
Over 80 "	1	-	-	1 (100%)

Results in Relation to Duration of Disease

The term "Duration of Disease" is here used to denote the period between the onset of symptoms and the application of Radium treatment to the metastases. This coincides with the appearance of the metastases and may therefore be taken as a rough index of the rate of growth.

Average Duration of Disease in cases treated ..... 24 months.

Duration	No. of Cases	Glands Disappeared	Glands Smaller	Not Improved
Under 1 year	5	1 (20%)	3 (60%)	1 (20%)
1 - 2 years	2	1 (50%)	-	1 (50%)
2 - 3 "	4	1 (25%)	3 (75%)	-
Over 3 "	4	1 (25%)	2 (50%)	1 (25%)

Results in Relation to Site of Primary Growth.

Site	No. of Cases	Glands Disappeared	Glands Smaller	Not Improved
Tongue, ant. 1/3	3	1 (33.3%)	-	2 (66.6%)
Tongue, mid. 1/3	6	2 (33.3%)	4 (66.6%)	-
Tongue, post 1/3	1	-	1 (100%)	-
Floor of Mouth	2	-	1 (50%)	1 (50%)
Alveolar Margin	1	1 (100%)	-	-
Palate	2	-	2 (100%)	-

Results in Relation to Site of Metastases.

Site	No. of Cases	Glands Disappeared	Glands Smaller	Not Improved
Submental Gland	1	1 (100%)	-	-
Submaxillary Gland (One side)	6	2 (33.3%)	4 (66.6%)	-
Submaxillary Gland (both sides)	3	-	1 (33.3%)	2 (66.6%)
Submental & Submaxillary Glands (one side)	2	1 (50%)	1 (50%)	-
Submaxillary & Deep Cervical Glands	3	-	2 (66.6%)	1 (33.3%)

CARCINOMA OF THE UPPER AIR PASSAGES.

In this group are included:-

Carcinoma of Larynx (Intrinsic).

Carcinoma of Pharynx.

Carcinoma of the Post-Cricoid Region.

Comparison of Results of Radiation Treatment of Carcinoma Upper Air Passages.

Author	Site of Growth	Method	No. of Cases	Survival in Years		
				5	3	2
Edling (14)	Larynx	Teletherapy	8	-	1 (12.5%)	2 (25%)
Quick (15)	Larynx	Teletherapy	165	12(7.3%)	3 (1.8%)	-
Harmer (16)	Larynx	Fenestration	11	-	-	1 (9%)
Edling (17)	Pharynx	Teletherapy	10	-	2 (20%)	1 (10%)
Quick (18)	Pharynx	Teletherapy	284	3 (1%)	4 (1.4%)	-

Berven (19) gives the following table showing the results of treatment of Hypopharyngeal Carcinoma by various methods at Radiumhemmet.

Period of Observation	All Cases		X-rays		Teletherapy		Combined	
	No.	Symptom Free	No.	Symptom Free	No.	Symptom Free	No.	Symptom Free
1 year	104	18 (17%)	45	3 (7%)	25	5 (20%)	34	10 (29%)
2 years	81	10 (12%)	43	3 (7%)	14	-	24	7 (29%)
3 years	65	6 (9%)	34	1 (3%)	13	-	18	5 (28%)
4 years	46	3 (7%)	26	-	12	-	8	3 (38%)
5 years	24	1 (4%)	14	-	6	-	4	1 (25%)

Comparison of Results of Surgical Treatment of Carcinoma Upper Air Passages.

Author	Site of Growth	No. of Cases	Operable	Actually Operated on	Surviving Operation
Zuppinger (20)	Pharynx & Post-Cricoid Region	120	17 (14.2%)	5 (4.1%)	Nil
Bilcher (21)	Pharynx & Post-Cricoid Region	100	49 (49%)	39 (39%)	7 (7%)
Trotter (22)	Pharynx & Post-Cricoid Region	?	?	?	8 ($3\frac{1}{2}$ - 20 yrs)

Results of Treatment of Intrinsic Carcinoma of Larynx.

Case No.	Age	Sex	Duration	Site of Primary Lesion
16	80 yrs.	Male	9 months	Right Vocal Cord, posterior 2/3
17	76 yrs.	Male	7 years	Right Vocal Cord, middle 2/3
18	71 yrs.	Male	1 year	Right Vocal Cord, anterior 1/2
19	58 yrs.	Male	18 months	Right Vocal Cord, middle 1/3

Analysis of Results.

All the cases are males and the Right Vocal Cord is involved in each instance.

Average Age of Patients ..... 71 years.

Average Duration of Disease ..... 30 months.

A study of the table shows no apparent relationship between the results of treatment and the age of the patient or the rate of growth of the disease.

Metastases	Immediate Result	Late Result
Glands involved Right side neck	Ulcer much smaller Glands not palpable	Residual thickening of Cord No recurrence - 1 year
Glands involved Right side neck	No active disease Glands smaller	Recurred - 4 months
Glands involved Both sides neck	Vocal Cord normal Glands not palpable	Recurred - 5 months
Glands involved Right side neck	No active disease Glands smaller	No disease in Larynx Small gland - 14 months

Results of Treatment of Carcinoma of Pharynx.

Case No.	Age	Sex	Duration	Site of Primary Lesion
20	65 yrs	Male	$4\frac{1}{2}$ years	Pyriform Fossa (left)
21	72 yrs.	Male	1 year	Pyriform Fossa (right)
22	77 yrs.	Male	6 months	Pyriform Fossa (right)
23	64 yrs.	Male	5 months	Pyriform Fossa (right)
24	66 yrs.	Male	6 months	Pyriform Fossa (right)
25	58 yrs.	Male	6 months	Pyriform Fossa (right)
26	66 yrs.	Male	6 weeks	Vallecula & Epiglottis
27	71 yrs.	Male	1 year	Vallecula & Epiglottis
28	57 yrs.	Male	9 months	Vallecula & Epiglottis
29	63 yrs.	Male	3 months	Vallecula
30	63 yrs.	Male	16 months	Vallecula
31	66 yrs.	Male	6 months	Vallecula & Epiglottis
32	64 yrs.	Male	2 months	Pharyngeal Wall (left)
33	54 yrs.	Male	1 year	Pharyngeal Wall (left)
34	69 yrs.	Male	10 months	Pharyngeal Wall (right)
35	70 yrs.	Female	9 months	Pharyngeal Wall (post.)

Metastases	Immediate Result	Late Result
Glands involved Left side neck	Ulcer smaller Glands smaller	Recurrence - 3 months Died
Glands involved Right side neck	Ulcer smaller Glands I.S.Q.	Recurrence - 5 months
Small gland Right side neck	Ulcer healed Glands smaller	Recurrence - 1 month Died - 2 months
Large gland mass Right side neck	No improvement	Died - 6 months
Small gland Right side neck	Ulcer much smaller Glands not palpable	No evidence of disease - 18 months
Small gland Right side neck	Ulcer healed Gland not palpable	No evidence of disease - 19 months
Large glands Both sides neck	Small nodule on Epiglottis. Glands smaller	Condition I.S.Q. - 6 months
Fixed glands Both sides neck	Small residual nodule, Glands smaller	Recurrence - 4 months
Glands involved Left side neck	Shallow ulcer persisting. Glands I.S.Q.	Recurrence - 5 months
Glands right neck & Supraclav. Fossa	Ulcer healed Glands smaller	Recurrence - 9 months Died - 13 months
Glands involved Both sides neck	Ulcer smaller Glands smaller	Small inactive ulcer - 14 months
Glands involved Left side neck	Ulcer healed Glands not palpable	No evidence of disease - 10 months
Small gland Left Carotid area	Ulcer healed Gland smaller	Recurrence - 6 months
Glands involved Left side neck	Ulcer healed Glands smaller	No evidence of disease - 8 months
Glands involved Right side nec k	Died - 1 month, from Carcinoma of Colon (Autopsy revealed no disease in Pharynx)	
Small gland Right side neck	Ulcer healed Gland not palpable	No evidence of disease - 15 months

Analysis of Results.

Total No. of cases 16

One case was a female .....i.e. 6.2%

All cases showed metastases in Cervical Glands and one case also in the Supra-clavicular Glands.

The primary growth and the metastases were treated simultaneously.

Degree of Improvement.

A. Apparently Cured (Ulcer healed, glands disappeared).... 4 cases (25%)

B. Improved (Ulcer and glands smaller) ..... 10 " (62.5%

C. Not improved ..... 1 case (6.2%)

D. Died from other causes ..... 1 " (6.2%)

A.

No signs of disease after 18 months ..... 1 case

" " " " " 15 " ..... 1 "

" " " " " 10 " ..... 2 cases

B.

Disease apparently inactive after 14 months ..... 1 case

" " " " 8 " ..... 2 cases

" " " " 6 " ..... 2 "

" " " " 5 " ..... 2 "

" " " " 4 " ..... 1 case

" " " " 3 " ..... 1 "

" " " " 1 month ..... 1 "

C.

No improvement: died in 6 months ..... 1 case.

D.

Died from other causes ..... 1 case.

(This patient died from Primary Carcinoma of Colon. Histological section of Pharyngeal Wall after autopsy revealed no evidence of the presence of Carcinoma). This case is omitted from the following tables.

Results in Relation to Age.

Average age of cases treated ..... 65 years.

Age Group	No. of Cases	Apparently Cured	Improved	Not Improved
51 - 60 yrs.	3	1 (33.3%)	2 (66.6%)	-
61 - 70 "	9	3 (33.3%)	5 (55.5%)	1 (11.1%)
Over 70 "	3	-	3 (100%)	-

Results in Relation to Duration of Disease.

Average Duration of Disease in cases treated ..... 10½ months.

Duration	No. of Cases	Apparently Cured	Improved	Not Improved
Under 3 months	3	-	3 (100%)	-
3 - 6 months	5	3 (60%)	1 (20%)	1 (20%)
6 - 9 "	2	1 (50%)	1 (50%)	-
9 - 12 "	3	-	3 (100%)	-
Over 12 "	2	-	2 (100%)	-

Results in Relation to Site of Primary Growth.

Site	No. of Cases	Apparently Cured	Improved	Not Improved
Pyriform Fossa	6	2 (33.3%)	3 (50%)	1 (16.6%)
Vallecula	6	1 (16.6%)	5 (83.3%)	-
Pharyngeal Wall	3	1 (33.3%)	2 (66.6%)	-

Results of Treatment of Post-Cricoid Carcinoma.

Case No.	Age	Sex	Duration	Site of Primary Lesion.
36	59 yrs.	Male	9 months	Post-Cricoid Region (left)
37	45 yrs.	Female	2 months	Post-Cricoid Region (left)
38	28 yrs.	Female	6 months	Post-Cricoid Region (left)
39	45 yrs.	Female	3 months	Post-Cricoid Region (right)
40	67 yrs.	Female	2 years	Post-Cricoid Region

Metastases	Immediate Result	Late Result
Nil found	Ulcer smaller Severe Reaction	Recurred - 5 months Died - 7 months
Nil found	Ulcer smaller Much oedema	Recurred - 6 months Di ed - 10 months
Fixed gland Left side neck	No improvement	Died - 2 months
Nil found	Ulcer edges healing	Recurred - 4 months
Nil found	Small residual ulcer	No evidence of disease - 10 months

Analysis of Results.

Total No. of cases 5

One case occurred in a male .....i.e. 20%

Only one case showed metastases in the Cervical Glands.

Degree of Improvement.

A. Ulcer healed ..... 1 case (20%)

B. Improved (ulcer reduced in size) ..... 3 cases (60%)

C. Not improved ..... 1 case (20%)

A.

No signs of disease after 10 months ..... 1 case

B.

Disease apparently inactive after 6 months.. 1 case

" " " " 5 " .. 1 "

" " " " 4 " .. 1 "

C.

Not improved: Died in 2 months ..... 1 case

Surgical Treatment.

Tracheotomy was resorted to in 2 cases.

Gastrostomy was resorted to in 3 cases.

Results in Relation to Age.

Average age of cases treated ..... 48 years.

Age Group	No. of Cases	Apparently Cured	Improved	Not Improved
Under 40 yrs.	1	-	-	1 (100%)
41 - 50 "	2	-	2 (100%)	-
51 - 60 "	1	-	1 (100%)	-
Over 60 "	1	1 (100%)	-	-

Results in Relation to Duration of Disease.

Average Duration of Disease in cases treated ..... 9 months.

Duration	No. of Cases	Apparently Cured	Improved	Not Improved
Under 6 months	2	-	2 (100%)	-
6 - 12 "	2	-	1 (50%)	1 (50%)
Over 12 "	1	1 (100%)	-	-

CARCINOMA OF THE BREAST.

Untreated Cases.

According to Rowntree (23), the average duration of life in untreated cases is 3½ years.

Comparison of Results of Radiation treatment in Carcinoma of Breast.

Author	Metastases	No. of Cases	3 years' Survival
Raven (24)	Nil	49	14 (28%)
Several Workers (25)	Present	23	8 (35%)
Several Workers (26)	Present	17	4 (23%)

Comparison of Results of Surgical treatment of Carcinoma of Breast.

Author	Metastases	No. of Cases	3 years' Survival
Dressier & Pelletier ('27)	Present	48	6 (12.5%)
Lee (28)	Present	191	29 (15%)
Raven (29)	Present	36	4 (11%)
Raven (30)	Nil	15	3 (20%)

Comparison of Results of Combined Radiation and Surgical treatment of Carcinoma of Breast.

Author	No. of Cases	5 years' Survival
Nicholson & Berman (31)	74	27 (36.5%)
Lee (32)	83	24 (29%)

Results of Treatment of Primary Carcinoma of Breast (Without Metastases)

Case No.	Age	Sex	Duration	Previous Treatment
41	76 yrs.	Female	3 months	Nil
42	75 yrs.	Female	4 years	Radium plaque - 3 years
43	79 yrs.	Female	18 months	Nil
44	68 yrs.	Female	3 months	Nil
45	76 yrs.	Female	4 weeks	Nil
46	73 yrs.	Female	8 years	Nil
47	64 yrs.	Female	6 months	Nil
48	81 yrs.	Female	2 months	Nil

Site of Tumour	Immediate Result	Late Result
Mobile nodule Axillary quadrant	Nodule smaller & softer	Condition stationary - 17 months
Ulcerated mass Axillary quadrant	Mass half former size. Ulcer healed	Mass present but inactive - 6 months
Ulcerated mass Axillary quadrant	Tumour and ulcer smaller	Mass present but inactive - 19 months
Mobile nodule Axillary tail	No tumour palpable	No tumour palpable - 9 months
Large nodule Axillary tail	Nodule smaller	Condition stationary - 4 months
Ulcerated mass Axillary quadrant	Mass smaller	Condition stationary - 3 months
Fixed mass below Areola	Mass smaller & mobile	Recurred Died - 8 months
Fixed nodule Axilla ry quadrant	Nodule smaller	Small nodule - inactive - 12 months

Analysis of Results.

Total No. of cases 8

All cases were females.

None of the cases showed glandular metastases.

All cases were inoperable.

Inoperable because of extent of disease .... 3 cases

" " " advanced age ..... 5 cases

Degree of Improvement.

A. Tumour disappeared ..... 1 case (12.5%)

B. Improved (tumour smaller) ..... 6 cases (75%)

C. Not improved ..... 1 case (12.5%)

A.

No evidence of disease after 9 months ..... 1 case

B.

Disease apparently inactive after 19 months ..... 1 case

" " " " 17 " ..... 1 "

" " " " 12 " ..... 1 "

" " " " 6 " ..... 1 "

" " " " 4 " ..... 1 "

" " " " 3 " ..... 1 "

C.

Not improved: died in 8 months ..... 1 case

Results in Relation to Age.

Average age of cases treated ..... 74 years.

A study of the table o f results shows that the age groups fall within very narrow limits around the average age, consequently the age factor cannot have influenced the results to any appreciable extent.

Results in Relation to Duration of Disease.

Average Duration of Disease in cases treated ..... 22 months.

Duration	No. of Cases	Apparently Cured	Improved	Not Improved
Under 12 months	5	1 (20%)	3 (60%)	1 (20%)
Over 12 "	3	-	3 (100%)	-

Results in Relation to Extent of Growth.

Mobility of Tumour	No. of Cases	Apparently Cured	Improved	Not Improved
Mobile	5	1 (20%)	4 (80%)	-
Adherent	3	-	2 (66.6%)	1 (33.3%)

Results of Treatment of Metastases from Carcinoma of Breast.

Case No.	Age	Sex	Duration	Previous Treatment
49	65 yrs.	Female	25 years	Radical Amputation - 1 year
50	48 yrs.	Female	3 years	Radical Amputation - 2 years Radium plaque - 18 months
51	40 yrs.	Female	3½ years	Local Excision - 1 month
52	49 yrs.	Female	4 years	Radical Amputation - 2 years
53	58 yrs.	Female	2 years	Radical Amputation - 18 months
54	51 yrs.	Female	9 months	Radical Amputation - 8 months
55	57 yrs.	Female	3 years	Radical Amputation - 2½ years
56	48 yrs.	Female	3 years	Radical Amputation - 2 years
57	52 yrs.	Female	18 months	Radical Amputation - 4 months
58	34 yrs.	Female	2 years	Radical Amputation - 19 months
59	56 yrs.	Female	4 years	Radical Amputation - 3½ years
60	62 yrs.	Female	2 years	Radical Amputation - 20 months
61	68 yrs.	Female	2 years	Radical Amputation - 17 months

Metastases	Immediate Result	Late Result
Axillary glands	Glands smaller	Pulmonary metastases Died - 2 months
Axillary glands	Glands smaller	Residual fibrosis only - 2 months
Axillary & Supra-clavicular glands	Glands not palpable	No evidence of disease + 15 months
Both supra-clavicular glands	Glands smaller	Multiple skin metastases - 3 months
Supraclavicular glands	Glands not palpable	No evidence of disease - 5 months
Supraclavicular glands	No improvement	Multiple metastases Died - 4 months
Supraclavicular glands	Glands smaller	Residual fibrosis only - 10 months
Supraclavicular glands	Glands not palpable	No evidence of disease - 6 months
Supraclavicular glands	Glands not palpable	No evidence of disease - 11 months
Supraclavicular glands	Glands smaller	Recurrence in glands - 6 months
Nodules in scar	Nodules disappeared	Pulmonary metastases - 5 months
Nodules in scar	Nodules disappeared	No evidence of disease - 10 months
Ulcerated nodules in scar	Nodules disappeared Ulcer healing	No evidence of disease - 9 months

Analysis of Results.

Total No. of cases 13

All cases were females.

All cases had previous surgical treatment to the primary growth:-

Radical Amputation ..... 12 cases

Local Excision of Tumour ..... 1 case

One case had Radium plaque treatment to the scar area following Radical Amputation.

Metastases in lymphatic glands ..... 10 cases

" " skin of scar ..... 3 "

Degree of Improvement.

A. Metastases disappeared ..... 7 cases (53.8%)

B. Improved (metastases smaller) ..... 5 " (38.4%)

C. Not improved ..... 1 case (7.7%)

A.

No evidence of disease after 15 months ..... 1 case

" " " " " 11 " ..... 1 "

" " " " " 10 " ..... 1 "

" " " " " 9 " ..... 1 "

" " " " " 6 " ..... 1 "

" " " " " 5 " ..... 2 cases

B.

Disease apparently inactive after 10 months ..... 1 case

" " 6 " ..... 1 "

" " 3 " ..... 1 "

" " 2 " ..... 2 cases.

C.

Not improved: died in 4 months ..... 1 case.

Results in Relation to Age.

Average age of cases treated ..... 53 years.

Age Group	No. of Cases	Apparently Cured	Improved	Not Improved
Under 40 yrs.	1	-	1 (100%)	-
41 - 50 "	4	2 (50%)	2 (50%)	-
51 - 60 "	5	3 (60%)	1 (20%)	1 (20%)
Over 60 "	3	2 (66.6%)	1 (33.3%)	-

Results in Relation to Duration of Disease.

i.e. from onset of symptoms to commencement of Teletherapy.

Average Duration of Disease in cases treated ..... 31 months.

(One case is excluded from this calculation. The disease began as a long-standing Chronic Mastitis and it is therefore impossible to determine accurately the onset of malignant changes.)

Duration	No. of Cases	Apparently Cured	Improved	Not Improved
Under 2 years	2	1 (50%)	-	1 (50%)
2 years	4	3 (75%)	1 (25%)	-
3 years	4	2 (50%)	2 (50%)	-
Over 3 years	2	1 (50%)	1 (50%)	-

Results in Relation to Site of Metastases.

Site	No. of Cases	Apparently Cured	Improved	Not Improved
Axillary Glands	2	-	2 (100%)	-
Supraclavicular Gl.	8	4 (50%)	3 (37.5%)	1 (12.5%)
Nodules in Skin	3	3 (100%)	-	-

These cases were not examined radiographically for the presence of Pulmonary or Bony Metastases, but there were no clinical signs of such at the time of treatment.

Incidence of Lung and Bone Metastases in Carcinoma of Breast.

Author	No. of Cases	Without Metastases	With Metastases		
			Lungs only	Bones only	Lungs & Bones
Dresser & Pelletier (33)	500	293 (58.6%)	73 (14.6%)	86 (17.2%)	48 (9.6%)

RESULTS OF ALL CASES TREATED.

Site of Disease	No. of Cases
Metastases from Carc. Tongue & B.Mucosa	15
Intrinsic Carcinoma of Larynx	4
Carcinoma of Pharynx	16
Carcinoma of Post-Cricoid Region	5
Primary Carcinoma of Breast	8
Metastases from Carcinoma of Breast	13
Total	61

No Evidence of Disease	Improved	Not Improved	Died from Other Causes
5 (33.3%)	7 (46.6%)	3 (20%)	-
1 (25%)	3 (75%)	-	-
4 (25%)	10 (62.5%)	1 (6.2%)	1 (6.2%)
1 (20%)	3 (60%)	1 (20%)	-
1 (12.5%)	6 (75%)	1 (12.5%)	-
7 (53.8%)	5 (38.4%)	1 (7.7%)	-
19 (31.1%)	34 (55.7%)	7 (11%)	1 (1.6%)

REVIEW OF RESULTS.

The work reviewed in this thesis is so recent that it is impossible to speak of "cures" in the sense in which the term is usually applied to malignancy, i.e. those cases which show no signs of recurrence of the disease over a period of not less than five years. And it is only by allowing such an interval to elapse before collecting statistics that a true estimate of the value of Radiation Therapy can be assessed.

As will be seen from the preceeding chapter, however, the figures are drawn from results at varying intervals up to about 18 months after the application of treatment. It is worth while, therefore, surveying those results on hand.

Metastases from Carcinoma of Tongue and Buccal Mucosa.

The comparison tables in this section reveal great variations among different workers. This can be accounted for by (a) the willingness of certain workers to accept for treatment obviously advanced c ases, (b) the quantity of Radium and facilities available and (c) variations in the technique employed. The latter is especially true of the "5-year" figures, since it is only very recently that any attempt has been made to standardise methods.

On first impression, the Surgical results seem much more satisfactory than those obtained with Radium but it must be remembered that only relatively early cases, in which the disease can be entirely eradicated, can

hope for cures by Surgery, whereas a much less stringent selection need be exercised on cases chosen for Teletherapy. In other words, Radium offers hope of improvement to a wider range of cases than does Surgery.

The success of Interstitial Needling has rendered it the method of choice in the treatment of primary cancer of the Buccal Epithelium, and this plan was followed in the cases de scribed in this thesis unless the presence of sloughing ulcers or sepsis contraindicated its use, in which case Diathermy Excision was carried out.

15 cases of glandular metastases were treated. 5 cases, (33.3%) showed no signs of recurrence after periods varying from 3 to 18 months. 7 cases, (46.6%) were definitely improved, while 3 cases (25%) did not respond.

The cases fall within a wide range of age groups, but the age factor did not appear to have any bearing on the results; nor did the duration of the disease before treatment. It is apparent, however, that metastases originating from cancers towards the tip of the Tongue tended to disappear more readily than those emanating from other situations in the mouth. This is not necessarily true of the primary growths in the mouth.

As is to be expected, when more than one set of glands were involved, or particularly when glands on both sides of the neck were affected, the results were poorer.

Carcinoma of the Upper Air Passages.

Growths of the Laryngeal and Pharyngeal Regions are from a technical point of view, admirably situated for Teletherapy. Their depth below the skin is sufficiently great to render them relatively immune to radiation delivered from surface plaques, while any attempt at the direct insertion of needles must necessitate the exposure of the growth by surgical means. Implantation of Radon Seeds has been tried, but difficulty in obtaining an adequate dosage and a satisfactory distribution has resulted in their disuse. The growths, on the other hand, are well within the lethal range of a 2-gramme Radium Bomb, and to irradiate the region uniformly is only a matter of experience in adjusting the ports of entry and dosage.

Reference to the tables of Surgical results in these cases will show how very unsatisfactory treatment has hitherto been, and in view of the distressing symptoms of the disease if allowed to follow its natural course, any measures which render the patient's condition more bearable are to be welcomed.

In all the cases treated in this group, with the exception of 4 of the Post-Cricoid carcinomas, the disease had spread to the Cervical Lymphatic Glands; and treatment fields were so devised that the metastases received radiation simultaneously with the primary growth. Indeed this could hardly be avoided as the glands lie superificial to the tumour.

There was no case for which Surgery offered a hope of cure.

Carcinoma of Larynx (Intrinsic).

4 cases were treated. In each instance the patient was a male and the right Vocal Cord was involved - this is true of a very large number of Intrinsic Laryngeal Cancers.

In 3 cases the primary growth was made to disappear, and in the fourth it was greatly reduced, while 2 of the cases showed no recurrence of the disease locally after an internal of one year.

No special factor was found which seemed to influence the response to Radium.

Carcinoma of Pharynx.

In this group a larger series of cases were investigated; 16 in all, and these included growths from the following sites:-

Pyriform Fossa ..... 6 cases,

Vallecula ..... 6 "

Pharyngeal Wall ..... 4 "

From their clinical characteristics and for the purpose of these notes, they may be described in one group. In all cases metastases were present in the Cervical Glands.

4 cases (25%) showed no evidence of the disease after intervals of from 10 to 18 months. 10 cases (62.5%) showed definite improvement, while the remaining 2 cases died - one from another cause.

The age of the patient did not appear to influence the result.

In nearly every case treatment was sought within 12 months from

the onset of symptoms, and as is to be expected, those cases in which treatment was instituted early showed the best response. Apparent cure was not attained in any case with a history longer than 9 months.

The exact site of the lesion made no difference to the prognosis.

Carcinoma of the Post-Cricoid Region.

Here 5 cases were dealt with, four of them being females. This is a common finding in cancers of the Post-Cricoid Region. Patients seek advice early because of the particularly disabling nature of the symptoms, which frequently necessitates a tracheotomy or gastrostomy. Unfortunately, radiation tends to produce a considerable degree of oedema locally, and that of itself may cause obstruction to the airway with marked dysphagia, to such an extent as to demand surgical intervention. The disease is usually fatal before metastases have developed.

One case showed no evidence of the disease after 10 months, but of the other 4 cases, while 3 were temporarily improved, all had recurrences in a few months.

Of the cancers of the Upper Air Passages, that in the Post-Cricoid Region affects a younger type of subject, and is more disappointing in its response to treatment. Generally speaking, the older the patient, the better are the chances of improvement, probably because the growth then tends to be less active, and since the patient usually dies from the sequelae of the obstructive symptoms rather than from a dissemination of the actual disease.

The results of the cases treated were on the whole, unsatisfactory.

Carcinoma of the Breast.

In this condition, provided the disease is clinically localised to the Breast, Radical Amputation offers prospect of cure in a very large number of cases, and is therefore, the line of treatment to be recommended.

In many patients in which spread has taken place beyond this area, however, although apparently the lymphatic system has been adequately removed at the time of operation and all traces of the cancer with it, the incidence of subsequent metastases is high. It is in an attempt to provide for this type of case that a combination of surgery and radiation therapy has been instituted, and indeed found to meet with a large degree of success. Preoperative radiation will often reduce an infiltrating growth so as to render it operable, and on the other hand, a post-operative course of radiation to the chest (whether by Radium or Deep X-rays) would appear to lessen the likelihood of recurrence.

Two types of cases remain, however, (a) the Breast Scirrhus in women who are unsuitable for surgical operation on account of age, etc., and (b) the glandular metastases supervening on radical removal of a Breast. These are the two classes examined in this thesis.

Primary Carcinoma of the Breast.

8 cases were treated. All cases were females, and were inoperable either on account of the extent of the disease or because of the advanced age of the patient. No glandular metastases were present in any of the cases.

The cancer was of the relatively slow-growing scirrhus type, and where surgical removal is impossible, Teletherapy would appear to be the most convenient method of arresting its spread.

One case showed no evidence of the disease 9 months after treatment, while 6 were improved for varying periods of from 3 to 19 months. One case did not respond to treatment.

The average age was 74 years, and all cases came within a few years of this. Consequently, the age factor did not influence the prognosis.

The duration of the disease before treatment varied considerably; the shortest was 4 weeks and the longest 8 years. The results were independent of this factor.

Tumours which were movable over the deep structures offered a much greater prospect of improvement than those which had become adherent - this is as would be expected, since the disease in the former case was clinically localised and a more efficient treatment was possible.

The Axillary quadrant is by far the most common site of Breast cancers, - of the 8 cases described, 7 occurred in the Axillary quadrant and one in the Nipple Region. The rich lymphatic network in this latter area predisposes to early dissemination and infiltration, and the prognosis is less hopeful.

Metastases from Carcinoma of Breast.

13 cases are des cribed. In all of them the primary growth had

previously been dealt with surgically. In 12 of the cases the measure adopted had been Radical Amputation, whilst in the other case local excision had been carried out.

10 cases now had metastases in the Axillary or Supra-clavicular Glands, and in the other 3 cases the recurrence took the form of nodules in the skin around the scar.

7 cases (53.8%) showed no evidence of the disease for periods of from 5 to 15 months after treatment (these included the 3 cases of skin recurrences). 5 cases (38.4%) were improved, and one case did not respond. In this latter instance the disease was extremely active and multiple metastases shortly supervened.

From the tables it would appear that the older age-groups offer a better chance of recovery, but the cases are too few to justify a general statement on this point.

The duration of the disease did not seem to prejudice the reaction.

Metastases in the Supra-clavicular Glands disappeared more readily than those in Axillary Glands; this, however, was probably due rather to the technical difficulty of treating the Axilla than to any inherent difference in the nature of the growths.

In the 3 cases of skin recurrence the nodules disappeared completely. Since skin nodules can be treated admirably by surface radiation it is really uneconomical to employ a bomb, but the cases are included here simply from the point of view of interest.

A considerable proportion of Breast cancers form metastases in the Lungs and Skeleton, but equipped with only 2 grammes of Radium, it is impossible to attempt treatment in these cases because of the extent and depth of the disease. At the present time Deep X-ray Therapy provides the most hopeful remedy.

All Cases.

Of the 61 cases described, 19 (31.1%) showed no evidence of the disease, 34 (55.7%) were improved, and 7 (11%) gave no response.

This series of cases is a fair selection of the varieties of cancer whose treatment is within the scope of a 2-gramme Radium Unit. They are types of tumour which by reason of the inaccessibility of their situation or the unsuitability or failure of other forms of treatment, have presented a difficult problem to the clinician, and the results described in this thesis show that the disease can often be made to disappear, or falling short of this ideal, at any rate its progress may frequently be held in check, so that the patient is enabled to carry on his life in much greater comfort than would otherwise be possible.

Teletherapy is not a cure for cancer any more than is Surgery or the other forms of Radiation Therapy, but it definitely does extend the range of therapeutical measures now available, and by so doing it deserves further investigation and development.

Whether any new advantages are to be gained by the massing together of greater quantities of the element must still remain to be seen.

SUMMARY.

1. The Bomb used contained 2 grammes of Radium.

2. The Bomb was as light as possible. The nose was of solid Gold so that the dimensions might be kept small and yet prevent lateral scatter of the rays.

3. The Bomb was freely movable in all directions. The adjustments to Bomb and patient were very simple so that the attendant was exposed in the vicinity of the Radium for only two minutes per treatment.

4. The ultimate aim in all Radium Therapy must be:

   (a) To destroy the cancer cells.

   (b) To stimulate the natural defensive mechanism of the body.

   (c) To minimise the damage to healthy tissues.

5. Treatment should be designed to deliver the maximum possible dose to the tumour without inflicting any permanent damage on the skin. By increasing the Radium-skin distance a greater Depth Dose can be obtained, but the tumour dose must be limited by the threshold of skin tolerance.

6. The skin is marked off in a number of "Ports of Entry," and these are treated in rotation, so that each area may recuperate between treatments.

7. Sufficient screenage is applied to the Radium to arrest the alpha, beta and soft gamma rays, as these are absorbed by the skin - only the hard gamma rays are used.

8. The basic principles of Distance Therapy are a narrow beam of radiation and multiplicity of ports of entry, combined with a "cross-fire" method of application.

9. Distance Therapy upsets the general metabolism to a lesser extent than Surface Radium Therapy.

10. The 61 cases treated included

Metastases in the Cervical Glands,

Cancers of the Upper Air Passages,

Primary cancers of the Breast,

Glandular metastases from cancers of the Breast.

11. The results described show that in a high percentage of cases the disease can be made to disappear, while in a great many more its progress may be checked.

12. Teletherapy extends the range of therapeutical measures now available for the treatment of cancer.

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CASE RECORDS.

Photographic records have not been made since the deep-seated nature of the disease renders it impossible thus to display the features of the condition.

Explanation of terms used in Records.

Condition: this describes the state of the disease found on examination of the patient at the beginning of treatment.

Treatment: the date given is that on which treatment commenced although the course usually lasted for several weeks.

Particulars of treatment are given in the following order:-

(1) No. of Ports of Entry used.

(2) Radium-skin Distance.

(3) Hours of application.

(4) Total dose in Milligramme-hours.

Inter. Irrad.; Interstitial Irradiation.

CASE NO. 1.

H. B.	62 years.	Male.
History.	Dec. 1932:	Small painful nodule on right side Tongue.
Condition:	Dec. 1933:	Large firm nodular mass on right margin of Tongue - anterior third. Tongue fixed. Metastases: Right submental gland, non-adherent. General condition: good.
Treatment.	15.12.33:	Inter. Irrad. to Tongue - 894 mgm. hrs.
	20.12.33:	Teletherapy to right side of neck. 5 ports, 3 cm., 10 hours. 20,000 mgm. hrs.
Result.	Immediate:	Primary lesion half former size. Glands not palpable.
	Jan. 1935:	Tongue healed well. No evidence of active disease. General condition: good.

CASE NO. 2.

J. T.	67 years.	Male.
History.	July 1934:	Ulcer on left margin of Tongue - middle third - growing rapidly.
	Sept. 1934:	Inter. Irrad. to Tongue - Dosage ?
Condition.	Nov. 1934:	Tongue healed. Residual fibrosis present. Metastases: Left submental & submaxillary glands, fixed. General condition: good.

Treatment. 23.11.34: Teletherapy to both sides of Neck.

5 ports, 5 cm., 68 hours. 136,000 mgm. hrs.

Result. Immediate: Marked oedema over treatment area.

Glands not palpable.

Sept.1935: No evidence of disease. Tissues soft to palpation.

General condition: good.

CASE NO. 3.

H. L. 54 years. Male.

History. Since 1919: Recurrent painful ulcers on Tongue.

Aug. 1934: Hard ulcer on tip of Tongue, gradually spreading.

Inter. Irrad. to Tongue - 273 mgm. hrs.

Condition. Nov. 1934: Indurated ulcer (2 cm. diameter) on anterior third of Tongue. Tongue fixed. Metastases: Large adherent gland masses both submaxillary regions.

General condition: very poor.

Treatment. 16.11.34: Teletherapy to both sides neck.

4 ports, 3 cm., 12 hours. 24,000 mgm. hrs.

Result. Immediate: No improvement in condition.

Jan.1935: Died from the disease.

CASE NO. 4.

E. W. 70 years. Male.

Result.
History. Apr. 1934: Small ulcer and burning sensation on dorsum of Tongue.

Condition. Oct. 1934: Indurated ulcer (3 cm. diameter) involving dorsum and left margin of Tongue - middle third. Tongue fixed. Metastases: Left submental & submaxillary glands. General condition: poor. Much pain.

CASE NO.

Treatment. 13.10.34: Inter. Irradiation to Tongue - 864 mgm. hrs.

History. 26.10.34: Teletherapy to both sides neck. 7 ports, 3 cm., 21 hours. 42,000 mgm. hrs.

Result. Immediate: Severe Radium reaction. Ulcer healing.

Condition. Glands much smaller. No pain.

Mar. 1935: Recurred. Tongue fixed. Dysphagia.

July 1935: Died from the disease.

Treatment.

CASE NO. 5.

W. T. 74 years. Male.

History. 1930: Ulcer left side of Tongue. Growing.

1931: Excision of ulcer. (Squamous-cell carcinoma).

Condition. Oct. 1934: Indurated ulcer (1 cm. diameter) on left side of Tongue - posterior third. Fixed.

		Metastases: Left submaxillary & superior & inferior deep cervical glands.
		General condition: poor.
Treatment.	30.10.34:	Teletherapy to both sides of neck.
		5 ports, 3 cm., 15 hours. 30,000 mgm. hrs.
Result.	Immediate:	Severe Radium reaction. Glands definitely smaller.
	May 1935:	Glands increasing and disease spreading rapidly.

CASE NO. 6.

M. P. 81 years. Male.

History.	Sept. 1933:	Ulcer on tip of Tongue.
Condition.	Mar. 1934:	Indurated ulcer (1 cm. diameter) on dorsum of Tongue - anterior third. Tongue fixed.
		Metastases: Both submaxillary glands, fixed.
		General condition: very poor. Senile.
Treatment.	19.3.34:	Teletherapy to both sides of neck.
		3 ports, 3 cm. 12 hours. 24.000 mgm. hrs.
Result.	Immediate:	No response to treatment.
	July 1934:	Died from the disease.

CASE NO. 7.

F. E. 51 years. Male.

History.	Nov. 1931:	Simple ulcer left side Tongue. Recently developed hard edges.
Condition.	Nov. 1933:	Indurated ulcer (1 cm. diameter) on left margin of Tongue - middle third. Metastases: Left submaxillary gland, fixed. General condition: very good.
Treatment.	9.11.33:	Inter. Irrad. to Tongue - 720 mgm. hrs.
	2.12.33:	Teletherapy to left side of neck. 4 ports, 3 cm., 24 hours. 48,000 mgm. hrs.
Result.	Immediate:	Tongue healed. Glands smaller. Marked induration in neck.
	Aug. 1934:	Recurrence. Widespread metastases.
	Oct. 1934:	Died from the disease.

CASE NO. 8.

J. A. 71 years. Male.

History.	1926:	Papilloma excised from left side Tongue.
	1931:	" " " right " "
	Jan.1934:	Increasing pain left side Tongue.
Condition.	May 1934:	Epithelioma on left margin of Tongue - middle third - extending to floor of mouth (5 x 4 cm.) Superficial glossitis. Tongue fixed. Metastases: Left submaxillary gland, fixed. General condition: poor.

Treatment. 7.5.34: Diathermy excision of ulcer.

17.7.34: Teletherapy to left side of neck.

4 ports, 3 cm., 54 hours. 108,000 mgm. hrs.

Result. Immediate: Very small residual ulcer left side Tongue.

No glands palpable. Fibrosis in neck.

Oct.1934: Died from recurrence of the disease.

CASE NO. 9.

C. R. 71 years. Female.

History. Feb.1934: Ulcer right margin of Tongue. Growing rapidly.

July 1934: Inter. Irrad. to Tongue. - 3,024 mgm. hrs.

Condition. Sept.1934: Residual ulcer on right margin of Tongue - middle thir d. (0.5 cm. diameter) Metastases: Both submaxillary glands, fixed. General condition: good.

Treatment. 27.9.34: Teletherapy to both sides o f neck.

4 ports, 3 cm., 12 hours. 24,000 mgm. hrs.

Result. Immediate: Glands slightly smaller.

Feb.1935: Rapidly growing recurrence.

CASE NO. 10.

C. L. 32 years. Female.

History. Aug.1931: Small ulcer right side Tongue. Cauterized.

Jan.1933: Ulcer recurred.

Condition.	Apr.1933:	Small raised ulcer (1 cm. diameter) on right margin of Tongue - middle third. Tongue freely mobile Metastases: Right submaxillary gland, fixed. General condition: Excellent.
Treatment.	22.4.33:	Inter. Irrad. to Tongue - 585 mgm. hrs.
	4.8.33:	Teletherapy to both sides of neck. 6 ports, 3 cm., 18 hours. 36,000 mgm. hrs.
Result.	Immediate:	Ulcer healed. Glands much smaller.
	Feb.1935:	No evidence of disease. General condition: very good.

CASE NO. 11.

W. S. 50 years. Male.

History.	Jan.1933:	Ulcer right side Floor of Mouth.
	June 1933:	Diathermy excision of ulcer. Recurred.
Condition.	Jan.1934:	Fungating mass (3 x 2 cm.) covering right half of Floor of Mouth and extending on to base of Tongue. Metastases: Right submaxillary & superior and inferior deep cervical glands, fixed. General condition: poor.
Treatment.	11.1.34:	Teletherapy to right side of neck. 3 ports, 3 cm., 7 hours. 14,000 mgm. hrs.
Result.	Immediate:	Primary growth reduced to 2/3 former size. Much cleaner. Glands unchanged.
	Mar.1934:	Died from the disease.

CASE NO.12.

W. G.	50 years.	Male.
History.	Nov.1931:	Ulcer on floor of Mouth - gradually spreading.
Condition.	June 1934:	Ulcer (3 x 2 cm.) on floor of Mouth, behind genu of mandible and extending over alveolar margin. Metastases: Right submaxillary gland, fixed. General condition: Poor.
Treatment.	8.6.34:	Teletherapy to right side of neck. 4 ports, 3 cm., 25 hours. 50,000 mgm. hrs.
Result.	Immediate:	Ulcer smaller. Glands smaller.
	Mar.1935:	Ulcer healed; small sequestrum separating from genu of mandible. Glands now 1/3 former size - stationary. General condition: good.

CASE NO. 13.

R. B.	78 years.	Male.
History.	June 1932:	Small wart on upper right alveolar margin.
	Feb.1934:	Small swelling on right side of neck.
Condition.	Apr.1934:	Irregular hard ulcer (2 cm. diameter) in sulcus between cheek and alveolus on right side. Floor of Mouth not involved. Metastases: Right submaxillary gland. General condition: good.
Treatment.	25.4.34:	Teletherapy to right side face and neck. 6 ports, 3 cm. 43 hours. 86,000 mgm. hrs.

Result. Immediate: Small flat residual ulcer. Gland not palpable.

June 1935: Ulcer healed. No palpable glands - small plaque of fibrosis in right submaxillary region.

General condition: good.

CASE NO. 14.

W. K. 54 years. Male.

History. Nov.1933: Sore throat. Swelling of Palate.

Condition. Feb.1934: Fungating mass (1.5 cm. diameter) on left side of Soft Palate; extending to but not involving left Tonsil. Metastases: Left submaxillary & superior deep cervical glands, fixed. General condition: very poor.

Treatment. 8.2.34: Teletherapy to left side of neck.

5 ports, 3 cm., 16 hours. 32,000 mgm. hrs.

Result. Immediate: Primary growth and glands greatly diminished.

Sept. 1934: Recurrence with extensive ulceration of soft palate.

CASE NO. 15.

A. S. 65 years. Male.

History. 1930: Growth on left side Hard Palate.

1931: Inter. Irrad. to ulcer - Dosage ?

Temporary improvement.

1933: Recurred.

Condition. July 1934: Ulcer (1 cm. diameter) perforating Palate.
Metastases: Left submaxillary gland.
General condition: good.

Treatment. 16.7.34: Teletherapy to left side neck.
2 ports, 3 cm., 6 hours. 12,000 mgm. hrs.

Result. Immediate: Ulcer edges healed. Glands reduced to small nodules.

Dec. 1934: Died from Pneumonia. Condition I.S.Q. when last seen.

CASE NO. 16.

J. D. 80 years. Male.

History. Dec.1933: Huskiness. Pain in right Ear.

Condition. Aug.1934: Growth involving posterior 2/3 of right Vocal Cord.
Cord fixed. Metastases: Small gland right side neck - fixed. General condition: good.

Treatment. 17.8.34: Teletherapy to right side of neck.
3 ports, 5 cm., 45 hours. 90,000 mgm. hrs.

Result. Immediate: Growth much smaller. Right Vocal Cord thickened.
Oedema of Arytenoids. No glands palpable.

Aug.1935: Small inactive ulcer on right Arytenoid.
Right Cord thickened. No palpable glands.
General condition: good.

CASE NO. 17.

T. V. 76 years. Male.

History. 1927: Huskiness.

Sept. 1934: Repeated slight haemoptyses. Wassermann reaction negative. No.T.B. found in sputum.

Condition. Oct. 1934: Growth occupying middle 2/3 right Vocal Cord. Cord fixed. Metastases: Small gland on right side neck, fixed. General condition: good.

Treatment. 15.10.34: Teletherapy to both sides of neck. 2 ports, 5 cm., 20 hours. 40,000 mgm. hrs.

Result. Immediate: Right Vocal Cord appears healthy. Both Cords thickened. Gland now almost impalpable.

Feb. 1935: Primary growth recurred. General condition: very poor.

CASE NO. 18.

M. K. 71 years. Male.

History. Apr. 1933: Sore throat. Troublesome cough.

Jan. 1934: Occasional haemoptyses. Dysphagia.

Condition. Apr. 1934: Growth involving anterior half of right Vocal Cord. Cord fixed. Metastases: Glands - size of walnut - both sides of neck. General condition: very poor.

Treatment. 6.4.34: Teletherapy to both sides of neck. 5 ports, 3 cm., 40 hours. 80,000 mgm. hrs.

Result. Immediate: Vocal Cords normal in appearance. No signs of disease in Pharynx. Slight oedema of Arytenoids.

Sept.1934: Recurrence on posterior third of Tongue. General condition: very bad.

CASE NO. 19.

S. P. 58 years. Male.

History. Mar.1933: Huskiness. Sore throat. Found to have a Carcinoma of the right Vocal Cord.

June 1933: Fenestration on right side of Larynx with application of Radium needles - 1,728 mgm. hrs. Good result.

Aug.1934: Swelling on right side of neck.

Condition. Oct.1934: Carcinoma of right Vocal Cord, sessile, and extending over middle portion of Cord but not approaching either commissure. Metastases: Gland mass on right side of neck, fixed. General condition: good.

Treatment. 18.10.34: Teletherapy to right side of neck. 4 ports, 5 cm., 83 hours. 166,000 mgm. hrs.

Result. Immediate: Marked oedema of Cords and Arytenoids. No evidence of disease in Larynx. Gland smaller.

Dec. 1935: No active disease. Small residual gland mass in neck - stationary. General condition: good.

CASE NO. 20.

S. J. C. 65 years. Male.

History. 1929: Occasional hoarseness.

Mar.1934: Sudden temporary loss of voice. Dysphagia. Pain in right Ear.

Condition. Apr.1934: Mass growing from left Pyriform Fossa and filling left half of Larynx, ulcerated on surface.
Metastases: gland on left side of neck, fixed.
General condition: fair.

Treatment. 19.4.34: Teletherapy to left side of neck.
3 ports, 3 cm., 24 hours. 48,000 mgm. hrs.

Result. Immediate: Growth definitely smaller. Much oedema of Glottis. Gland diminished.

Aug.1934: Died from the disease following rapid recurrence of growth necessitating Tracheotomy.

CASE NO. 21.

E. R. B. 72 years. Male.

History. July 1933: Sore throat. Dysphagia. Slight haemoptysis.

Condition. July 1934: Growth involving right Pyriform Fossa.
Right Arytenoid fixed and oedematous.
Metastases: Gland on right side of neck, fixed.
General condition: good.

Treatment. 14.7.34: Teletherapy to right side of neck.

4 ports, 5 cm., 29 hours. 58,000 mgm. hrs.

Result. Immediate: No evidence of active disease in Pyriform Fossa. Glands reduced.

Dec.1934: Recurrence of primary growth. Glands much larger and extensive. General condition: poor.

CASE NO. 22.

G. T. 77 years. Male.

History. Apr.1934: Sore throat. Dysphagia. Cough.

Condition. Oct.1934: Growth in right Pyriform Fossa involving Arytenoid. Metastases: Small gland in right Carotid region. General condition: poor.

Treatment. 1.10.34: Teletherapy to right side of neck.

4 ports, 5 cm., 50 hours. 100,000 mgm. hrs.

Result. Immediate: Oedema of Larynx. No evidence of growth. Right Vocal Cord fixed. Gland I.S.Q.

Nov.1934: Rapidly growing recurrence of primary.

Dec.1934: Died from the disease.

CASE NO. 23.

G. N. 64 years. Male.

History. Jan.1934: Severe cough. Increasing dysphagia. Loss of voice. Rapid loss of weight.

Condition. May 1934: Massive ulcerated tumour from right Pyriform Fossa, extending into Pharynx. Oedematous. Both Vocal Cords fixed. Metastases: Large fixed gland mass on right side of neck. General condition: poor.

Treatment. 16.5.34: Teletherapy to right side of neck. 4 ports, 5 cm., 36 hours. 72,000 mgm. hrs.

Result. Immediate: Treatment discontinued on account of oedema. Condition unchanged.

Dec.1934: Died from the disease.

CASE NO. 24.

F. A. 66 years. Male.

History. May 1933: Cough and dyspnoea. Marked loss of weight.

Condition. Nov.1933: Large cauliflower growth arising from right Pyriform Fossa, ulcerated and extending laterally. Metastases: Small gland on right side of neck. General condition: good.

Treatment. 22.11.33: Teletherapy to right side of neck. 5 ports, 3 cm., 31 hours. 62,000 mgm. hrs.

Result. Immediate: Marked oedema of Larynx. Small residual ulcer at

site of lesion. Gland disappeared.

May 1934: No evidence of disease. General condition: very good.

CASE NO. 25.

W. J. 58 years. Male.

History. Dec,1933: Discomfort in right side of throat.
Cough. Occasional dysphagia.

Condition. May 1934: Cauliflower growth from right Pyriform Fossa, involving edge of Epiglottis. No ulceration.
Metastases: Small gland on right side of neck.
General condition: satisfactory.

Treatment. 18.5.34: Teletherapy to right side of neck.
4 ports, 3 cm., 27 hours. 54,000 mgm. hrs.

Result. Immediate: Oedema of Larynx. No obvious disease.
No gland palpable.

Mar.1935: No evidence of disease.
General condition: good.

CASE NO. 26.

S. L. 66 years. Male.

History. July 1934: Sore throat. Huskiness. Dysphagia.

Condition. Aug.1934: Ulcerated growth involving Vallecula and Epiglottis.
Metastases: Fixed gland masses on both sides of neck.
General condition: poor.

Treatment. 16.8.34: Teletherapy to both sides of neck.

7 ports. 5 cm., 67 hours. 134,000 mgm. hrs.

Result. Immediate: Residual nodule on Epiglottis. Glands much diminished.

Feb.1935: Disease apparently stationary.

General condition: I.S.Q.

CASE NO. 27.

M. K. 71 years. Male.

History. Apr.1933: Sore throat. Huskiness. Cough.

Dysphagia. Occasional haemoptyses.

Condition. Apr.1934: Extensive ulcer destroying Epiglottis, reaching to and involving Arytenoids. Metastases: Fixed gland masses both sides neck. General condition: poor.

Treatment. 6.4.34: Teletherapy to both sides of neck.

5 ports. 3 cm., 40 hours. 80,000 mgm. hrs.

Result. Immediate: Small residual ulcer on back of Tongue. Edges healing.

Oedema of Arytenoids. Glands smaller.

Aug.1934: Recurrence of the disease locally.

General condition: very poor.

CASE NO. 28.

D. F. 57 years. Male.

History. June 1933: Huskiness. Dysphagia. Slight haemoptyses.

Condition.	Mar.1934:	Ulcerative lesion in Vallecula, perforating base of Epiglottis and extending on to left Pharyngeal wall. Metastases: Glands left side neck. General condition: poor.
Treatment.	5.3.34:	Teletherapy to left side of neck. 3 ports, 3 cm., 35 hours. 70,000 mgm. hrs.
Result.	Immediate:	Shallow ulcer persisting at base of Epiglottis, Marked oedema. Glands unchanged.
	Aug.1934:	Died from the disease.

CASE NO. 29.

F. J. 63 years. Male.

History.	Aug.1933:	Noticed lump on right side of neck. No other symptoms.
Condition.	Nov.1933:	Small ulcer crater on Vallecula. Metastases: Fixed gland mass at angle of Jaw on right side. General condition: good.
Treatment.	5.11.33:	Teletherapy to right side of neck. 4 ports, 3 cm., 55 hours. 110,000 mgm. hrs.
Result.	Immediate:	Ulcer completely healed. Thickening and induration persisting in neck.
	July 1934:	Recurrence of ulcer. Extensive metastases in neck.
	Dec.1934:	Died from the disease.

CASE NO. 30.

J. B. 63 years. Male.

History. July 1932: Pain left side Throat. Dysphagia. Cough.

Condition. Nov.1933: Ulcer crater in Vallecula and small nodule on base of Tongue. Metastases: Hard gland mass in r ight side neck, small mobile glands in left side neck. General condition: good.

Treatment. 23.11.33: Teletherapy to both sides of neck.
6 ports, 3 cm., 43 hours. 86,000 m gm. hrs.

Result. Immediate: Ulcer and glands smaller.
Jan.1935: Small residual inactive ulcer in Vallecula. Still slight oedema. Small palpable gland right side neck. General condition: improved.

CASE NO.31.

B. T. 66 years. Male.

History. Jan.1934: Sore throat. Dysphagia. Slight cough.

Condition. July 1934: Large cauliflower mass replacing Epiglottis and extending in substance of Tongue, breaking through mucosa on left lateral margin. Ulcer crater in Vallecula. Metastases: Gland mass at angle of Jaw on left side. General condition: good.

Treatment. 30.7.34: Teletherapy to both sides of neck.
6 ports, 5 cm., 54 hours. 108,000 mgm. hrs.

Result. Immediate: Oedema but no signs of growth. Glands disappeared.

May 1935: No signs of disease. General condition: excellent.

CASE NO. 32.

G. N. 64 years. Male.

History. Mar.1934: Hard swelling on left side of neck. Dysphagia. Huskiness. Cough.

Condition. May 1934: Massive ulcerated growth on left Pharyngeal wall, involving left arytenoid. Metastases: Small fixed glands along left Carotid. General condition: good.

Treatment. 24.5.34: Teletherapy to both sides neck.

5 ports, 3 cm., 37 hours. 74,000 mgm. hrs.

Result. Immediate: No growth visible. Much oedema around Glottis. Glands still present.

Nov.1934: Died from recurrence of the Disease.

CASE NO. 33.

M. F. 54 years. Male.

History. Sept.1933: Sore throat. Swelling on left side of neck later.

Condition. Sept.1934: Ulcerated growth on left Pharyngeal wall. Metastases: Fixed gland mass at upper end of left Sterno-mastoid. General condition: very good.

Treatment. 24.9.34: Teletherapy to left side of neck.

4 ports, 5 cm., 5½ hours. 104,000 mgm. hrs.

Result. Immediate: Lesion healed. Glands greatly diminished.

May 1935: No evidence of disease in throat. Residual fibrosis in neck, glands stationary.

General condition: very satisfactory.

CASE NO. 34.

A. N. 69 years. Male.

History. Dec.1933: Dysphagia. Cough.

Sept. 1934: Swelling on right side of neck.

Condition. Oct. 1934: Growth on right Pharyngeal wall behind Tonsil.

Metastases: Fixed gland mass at upper end of right Sterno-mastoid. General condition: poor.

Treatment. 23.10.34: Teletherapy to right side of neck.

5 ports, 5 cm., 22 hours. 44,000 mgm. hrs.

Result. Immediate: (1 month) Died from Carcinoma of Colon. Autopsy and subsequent Histology revealed no evidence of disease on Pharynx.

CASE NO. 35.

E. M. 70 years. Female.

History. Apr.1933: Pain in back of throat. Dysphagia. Slight cough.

Condition. Jan.1934: Ulcerated tumour on posterior Pharyngeal wall, extending from abowe Uvula down to Vocal Cords, and from one Tonsil to the other.
Metastases: Small gland on right side of neck.
General condition: good.

Treatment. 10.1.34: Teletherapy to both sides of neck.
8 ports, 3 cm., 43 hours. 86,000 mgm. hrs.

Result. Immediate: Tumour completely disappeared. No glands palpable.
Apr.1935: No evidence of disease. General condition: very good

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CASE NO. 36.

R. R. 59 years. Male.

History. Aug.1933: Huskiness. Sore throat. Dysphagia.
Occasional slight haemoptyses.

Condition. May 1934: Growth in left Post-Cricoid region, extending down Oesophageal wall for 5 cm. Metastases: No glands involved. General condition: fairly good.

Treatment. 10.5.34: Teletherapy to left side of neck.
4 ports, 3 cm., 20 hours. 40,000 mgm. hrs.
(Treatment discontinued on account of severe Radium reaction).

Result. Immediate: Growth smaller.
Oct.1934: Recurrence of growth. Tracheotomy and Gastrostomy performed.
Dec.1934: Died from the disease.

CASE NO. 37.

N. M'M.	43 years.	Female.
History.	Dec.1933:	Progressive dysphagia. Haemoptyses.
Condition.	Feb.1934:	Typical Post-Cricoid Carcinoma - ulcer with definite edge. Metastases: No glands involved. General condition: poor.
Treatment.	15.2.34:	Teletherapy to both sides of neck. 4 ports, 3 cm., 32 hours. 64,000 mgm. hrs. Gastrostomy performed during course of treatment, on account of oedema).
Result.	Immediate:	Tumour greatly reduced.
	Aug.1934:	Recurrence. Sloughing lesion on posterior Pharyngeal wall. Glands involved on left side of neck.
	Dec.1934:	Died from the disease.

CASE NO. 38.

E. C.	28 years.	Female.
History.	Apr.1933:	Huskiness. Dysphagia. Severe Haemoptyses.
	Sept.1933:	Gastrostomy performed.
Condition.	Oct.1933:	Large mass growing from Post-Cricoid region and spreading to left Vocal Cord. Metastases: Fixed gland mass left side neck. General condition: very poor.

Treatment. 3.10.33: Teletherapy to left side of neck.

6 ports, 3 cm., 39 hours. 78,000 mgm. hrs.

Result. Immediate: No improvement in condition. Tracheotomy performed.

Dec.1933: Died from the disease.

CASE NO. 39.

E. J. 45 years. Female.

History. Aug.1934: Slight cough. Dysphagia. Marked loss of weight.

Condition. Nov.1934: Irregular ulcer in Post-Cricoid region.

Metastases: No glands involved.

General condition: good.

Treatment. 29.11.34: Teletherapy to both sides of neck.

4 ports, 5 cm., 74 hours. 148,000 mgm. hrs.

Result. Immediate: Small residual ulcer with healing edge in right Post-Cricoid region. General condition satisfactory.

Mar.1935: Recurrence. Disease spreading actively.

General condition: Deteriorating rapidly.

CASE NO. 40.

M. E. 67 years. Female.

History. 1932: Chronic cough. Feeling of lump in throat.

Choking sensation.

Condition.	July 1934:	Ulcer in Post-Cricoid region with large fleshy mass extending up to Epiglottis. Metastases: No glands involved. General condition: good.
Treatment.	12.7.34:	Teletherapy to both sides of neck. 4 ports, 3 cm., 30 hours. 60,000 mgm. hrs.
Result.	Immediate:	Small flat ulcer persisting on left side.
	May 1935:	No evidence of disease in throat. No glands involved. Patient very well.

CASE NO. 41.

A. T. 76 years. Female.

History.	July 1933:	Painless lump in right Breast. (Diabetic).
Condition.	Oct.1933:	Mobile hard mass in Axillary quadrant of right Breast. Metastases: Nil found. General condition: excellent.
Treatment.	29.10.33:	Teletherapy to tumour and axilla. 4 ports, 3 cm., 30 hours. 60,000 mgm. hrs.
Result.	Immediate:	Tumour smaller and softer.
	Dec.1934:	Condition stationary. Disease inactive. Residual fibrosis. General condition: excellent.

CASE NO. 42.

E. G.	75 years.	Female.
History.	1930:	Lump in right Breast.
	Apr.1931:	Radium plaque to Breast - Dosage ?
	Apr.1934:	Tumour ulcerated through skin.
Condition.	June 1934:	Large fixed mass occupying whole axillary quadrant of right breast. Ulcerated on surface (5 cm. diameter). Metastases: Nil found. General condition: good.
Treatment.	11.6.34:	Teletherapy to tumour and axilla. 5 ports, 3 cm., 28 hours. 56,000 mgm. hrs.
Result.	Immediate:	Mass reduced to half former size. Ulcer healed.
	Dec.1934:	Tumour unchanged. Apparently inactive. No metastases found. General condition: good.

CASE NO. 43.

M. G.	79 years.	Female.
History.	Mar.1932:	Lump in left Breast. Surface ulcerated.
Condition.	Sept.1933:	Fixed tumour mass (10 x 8 cm.) in axillary quadrant of left Breast. Metastases: Nil found. General condition: Good.
Treatment.	28.9.33:	Teletherapy to tumour and axilla. 5 ports, 3 cm., 31 hours. 62,000 mgm. hrs.

Result. Immediate: Tumour now 2/3 former size. Ulcer much smaller.

Apr.1935: Tumour slightly smaller. Ulcer healed.

No metastases found. General condition: improved.

CASE NO. 44.

H. B. 68 years. Female.

History. Mar.1934: Small lump under left Arm.

Condition. June 1934: Small mobile nodule in axillary tail of left Breast.

Metastases: Nil found. General conditions excellent.

Treatment. 24.6.34: Teletherapy to tumour and axilla.

5 ports, 3 cm., 68 hours. 136,000 mgm. hrs.

Result. Immediate: No tumour palpable in Breast.

Mar.1935: No evidence of disease. Patient well.

CASE NO. 45.

E. B. 76 years. Female.

History. Dec.1934: Lump in right Breast.

Condition. Jan.1935: Small mobile tumour in axillary tail of right Breast.

Metastases: Nil found. General conditions excellent.

Treatment. 17.1.35: Teletherapy to tumour.

4 ports, 5 cm., 32 hours. 64,000 mgm. hrs.

Result. Immediate: Tumour definitely diminished.

May 1935: No evidence of active disease. Condition stationary.

General condition: excellent.

CASE NO. 46.

E. L. B.	73 years.	Female.
History.	1927:	Lump in left Breast.
	1933:	Surface ulcerated.
Condition.	Feb.1935:	Adherent tumour (4 x 3 cm.) in axillary quadrant of left Breast. Metastases: Nil found. General condition: good.
Treatment.	15.2.35:	Teletherapy to tumour. 4 ports, 5 cm., 28 hours. 56,000 mgm. h rs.
Result.	Immediate:	Tumour now half former size. Ulcer edges healing. Marked Radium reaction.
	May 1935:	Disease stationary. Ulcer healed. Fibrosis around tumour. General condition: very good.

CASE NO. 47.

C. T.	64 years.	Female.
History.	Oct.1933:	Lump under nipple of left Breast.
Condition.	Apr.1934:	Mass, size of orange, under nipple of left Breast, fixed to skin and deep structures. Metastases: Nil found. General condition: good. Slight anaemia.
Treatment.	4.4.34:	Teletherapy to tumour. 6 ports, 3 cm., 18 hours. 36,000 mgm. hrs.
Result.	Immediate:	Tumour slightly smaller and mobile over deep structures
	Dec.1934:	Died from recurrence of the disease.

CASE NO. 48.

A. B.	81 years.	Female.
History.	Mar. 1934:	Lump in left Breast.
Condition.	May 1934:	Tumour (5 cm. diameter) in axillary quadrant of left Breast, adherent to skin but mobile over deep structures. Metastases: Nil found. General condition: very good.
Treatment.	26.5.34:	Teletherapy to tumour. 3 ports, 3 cm. 22 hours. 44,000 mgm. hrs.
Result.	Immediate:	Tumour much smaller.
	May 1935:	Tumour still smaller. Disease not clinically active. General condition: excellent.

CASE NO. 49.

S. S.	65 years.	Female.
History.	1909:	Chronic mastitis in right Breast.
	July 1933:	Biopsy - "Carcinoma". Radical Amputation.
Condition.	July 1934:	Scar healed well. Fixed gland mass in right axilla. Oedema of arm. General condition: poor.
Treatment.	10.7.34:	Teletherapy to glands. 2 ports, 3 cm., 14 hours. 28,000 mgm. hrs.
Result.	Immediate:	Glands slightly smaller. Oedema of arm more severe.
	Sept. 1934:	Died from multiple metastases in both Lungs.

CASE NO. 50.

E. J.	48 years.	Female.
History.	Jan.1932:	Lump in right Breast.
	Mar.1933:	Radical amputation of right Breast.
	Sept.1933:	Radium plaque to breast area - 23,200 m.h.
	Jan.1935:	Lump in right axilla.
Condition.	Mar.1935:	Fixed gland mass in right axilla.
		G eneral condition: good.
Treatment.	14.3.35:	Teletherapy to glands.
		2 ports, 5 cm. 18 hours. 36,000 mgm. hrs.
Result.	Immediate:	Glands diminished.
	May 1935:	Only residual fibrosis remaining.
		General condition: excellent.

CASE NO. 51.

H. F.	40 years.	Female.
History.	July 1930:	Lump in right Breast.
	Dec.1933:	Simple excision of mass (Carcinoma)
Condition.	Jan.1934:	Healthy scar. Metastases: Glands in right axilla and right supra-clavicular fossa. General condition: excellent.
Treatment.	22.1.34:	Teletherapy to scar area and glands.
		6 ports, 3 cm., 18 hours. 36,000 mgm. hrs.

Result. Immediate: Glands not palpable. General condition: excellent.

Apr.1935: No evidence of active disease. Patient very well.

CASE NO. 52.

G. H. 49 years. Female.

History. 1930: Lump in right Breast.

1932: Radical amputation of right Breast.

Condition. Aug.1934: Well-healed scar. Metastases: Fixed gland masses in both supra-clavicular fossae. General condition: poor.

Treatment. 28.8.34: Teletherapy to scar and both gland masses.

3 ports, 3 cm., 9 hours. 18,000 mgm. hrs.

Result. Immediate: Both glands smaller.

Nov.1934: Multiple skin metastases. General condition: very poor.

CASE N O. 53.

F. S. 58 years. Female.

History. Nov.1932: Lump in left Breast.

May 1933: Radical amputation of left Breast.

Oct.1934: Lump in left supra-clavicular fossa.

Condition. Dec.1934: Healthy scar. Metastases: Fixed gland mass in left supra-clavicular fossa. General condition: very good.

Treatment. 20.12.34: Teletherapy to glands.

1 port, 5 cm. 12 hours. 24,000 mgm. hrs.

Result. Immediate: Glands disappeared.

May 1935: No evidence of recurrence. Patient well.

CASE NO. 54.

M. D. 51 years. Female.

History. Mar.1934: Lump in left Breast.

Apr.1934: Radical amputation of Breast.

Condition. Dec.1934: Scar healthy. Metastases: Small gland in right supra-clavicular fossa. General condition: good.

Treatment. 26.12.34: Teletherapy to gland.

2 ports, 3 cm., 6 hours. 12,000 mgm. hrs.

Result. Immediate: Gland showed no change.

Apr.1935: Died from multiple metastases.

CASE NO. 55.

C. W. 57 years. Female.

History. 1931: Small nodule in left Breast. Radical amputation. (Carcinoma).

Dec.1933: Hard mass in left side of neck.

Condition. Feb.1934: Scar healthy. Metastases: Glands in left supra-clavicular fossa, fixed. General condition excellent.

Treatment. 9.2.34: Teletherapy to glands.

4 ports, 3 cm., 40 hours. 80,000 mgm. hrs.

Result. Immediate: Gland mass greatly diminished and mobile.

Dec.1934: Fibrosis in supra-clavicular fossa.

No evidence of recurrence. Patient well.

CASE NO. 56.

W. R. 48 years. Female.

History. 1931: Lump in left Breast.

Nov.1932: Radical amputation of Breast.

Condition. Dec.1934: Scar healthy. Metastases: Small gland mass in left supra-clavicular fossa. General condition: very good.

Treatment. 13.12.34: Teletherapy to gland.

2 ports, 3 cm., 6 hours. 12,000 mgm. hrs.

Result. Immediate: No palpable glands.

June 1935: No signs of disease. Patient very well and going abroad.

CASE NO. 57.

J. L. 52 years. Female.

History. Dec.1932: Lump in right Breast.

Feb.1934: Radical amputation of Breast.

Condition. June 1934: Scar healthy. Metastases: Glands in right supra-clavicular fossa. General condition: Excellent.

Treatment. 8.6.34: Teletherapy to gland.

1 port, 5 cm., 10 hours. 20,000 mgm. hrs.

Result. Immediate: Gland disappeared.

May 1935: No signs of disease. Patient well.

CASE NO. 58.

M. H. 34 years. Female.

History. Nov.1932: Lump in right Breast.

Mar.1933: Radical amputation of Breast.

Condition. Oct.1934: Scar healthy. Metastases: Fixed gland mass in right supra-clavicular fossa. General condition: Good.

Treatment. 22.10.34: Teletherapy to gland mass.

2 ports, 5 cm., 15 hours. 30,000 mgm. hrs.

Result. Immediate: Gla nd still present but definitely smaller.

Apr.1935: Glands much larger. Oedema of arm.

CASE NO. 59.

V. P. 56 years. Female.

History. 1930: Lump in left Breast.

Mar.1931: Radical amputation of Breast.

Condition. Sept.1934: Several small nodules in skin of scar.

Metastases: No glands involved.

General condition: poor.

Treatment. 12.9.34: Teletherapy to nodules in scar.

1 port, 3 cm., 3 hours. 6,000 mgm. hrs.

Result. Immediate: Nodules completely disappeared.

Feb.1935: No sign of disease locally. (X-ray shows miliary deposits in both lungs).

General condition: very poor.

CASE NO. 60.

G. H. 62 years. Female.

History. July 1932: Lump in left Breast.

Nov.1932: Radical amputation of Breast.

Condition. July 1934: Multiple skin recurrences at middle of scar.

No glands involved. General condition: very good.

Treatment. 8.7.34: Teletherapy to skin nodules.

3 ports, 3 cm., 9 hours. 18,000 mgm. hrs.

Result. Immediate: Nodules disappeared.

May 1935: Patient well. No further recurrences.

CASE NO. 61.

E. S. G. 68 years. Female.

History. Sept.1 932: Lump in left Breast.

Mar.1933: Radical amputation of Breast.

Condition. Aug.1934: Small cluster of nodules in scar - ulceration (1 cm. diameter). No glands involved.

General condition: good.

Treatment. 15.8.34: Teletherapy to nodules in scar.

1 port, 3 cm., 3 hours. 6,000 mgm. hrs.

Result. Immediate: Nodules disappared. Ulcer healing.

May 1935: Ulcer healed. No evidence of the disease.

Patient well.
