RADIOTHERAPY IN ITS RELATION TO DERMATOLOGY*

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The art and science of radiotherapy has been closely associated with dermatology ever since the first attempts at treatment with x rays were made within a few months of Röntgen's epoch-making discovery in November, 1895. It was the evidence of erythema of the skin, of dermatitis, and of necrotic ulceration, produced accidentally on the exposed hands and faces of enthusiastic workers or during prolonged demonstrations of the properties of the new-found rays, that gave the first indication of a biological reaction. Similarly the biological action of radium was discovered by the recognition of radium-produced dermatitis by Walkoff in 1900, and by the famous Becquerel burn in 1901 (Becquerel and Curie, 1901). Becquerel carried some radium in his waistcoat pocket and subsequently developed a painful ulcer on his chest wall.

Since those early days radiotherapy, by the use either of x rays or of the radiations from radioactive substances—in particular radium and radon and more recently some radioactive isotopes—has been used with benefit in a great number and variety of dermatological conditions. It has brought to dermatological practice an important method of treatment. Indeed, it is probably no exaggeration to say that for many dermatologists radiotherapy has been their most important single therapeutic agent. At the same time it must not be forgotten that radiotherapy has also brought to dermatology some new and difficult problems in the form of pathological conditions which are among the most distressing and tragic, and the most resistant to treatment which can occur.

In the content of this lecture it is not possible to describe all the dermatological conditions for which radiotherapy may be of value, but some discussion of the main groups and the underlying principles may be of interest.

In dermatological practice the effect which is required by radiotherapy is usually one which is limited to the skin and immediate subcutaneous tissues. It is therefore desirable to use a type of radiation which is soft and absorbed in the surface layers and does not penetrate deeply into the body. This is obtained by x rays of low voltage or by the beta rays from radium or other radioactive substances. There is no necessity, and it is undesirable, to use more penetrating radiation such as is useful for more deeply seated neoplasms, except in the case of some of the more infiltrating malignant skin tumours. What is commonly known as superficial x -ray therapy—that is, x rays generated at a tension of not more than 100 kV, and lightly filtered radium plates which allow a high proportion of the beta rays to emerge, have been the main methods of radiotherapy for skin diseases. In more recent years some beta-

emitting isotope such as P^{32} or strontium⁹⁰ has been used as a substitute for radium with certain advantages.

Action of Radiation in Dermatology

The use of radiotherapy in dermatology may be grouped into three main types of technique, each used for the treatment of distinct and different groups of disease with different dosage levels and with the object of producing different biological effects.

1. *Multiple Small Doses.*—A technique of multiple small doses is used for the treatment of inflammatory conditions and of many dermatoses. The size of each dose is often less and usually not more than 100 r—about a quarter of that which would produce a visible erythema—and the intervals between each dose are usually of about a week. It may be repeated four or five times in a course of treatment, but the repetitions must be strictly limited, as even with such small doses harmful sequelae will occur after prolonged or multiple courses of treatment. From the earliest days of x -ray therapy it became known that many inflammatory conditions, both acute and chronic, would regress and subside after such small doses of radiation, but although much work has been done and many facts have been accumulated the true nature of the action of radiation in effecting such results is not known. Theories have been advanced that the action is primarily on the blood vessels, causing dilatation and diapedesis, or that there is a destructive effect on the most sensitive cells, the lymphocytes, which are accumulated in the tissues irradiated, with the liberation of antibodies, or a destructive effect on developing fibroblasts. Whatever the exact mechanism may be there is some definite reaction produced, without any clinical erythema, which promotes the regression of these pathological processes. Similar techniques are used in the treatment of some haemangiomas in children and for keloids.

2. *Single Dose.*—A single-dose technique is used to produce temporary epilation in cases in which there is infection deep in the hair follicles. The dose given is one which will produce a mild erythema—that is, between 400 and 500 r with this quality of radiation—and it acts by causing damage to the sensitive cells lining the hair follicles. The hair falls out, leaving the follicles open and amenable to the application of fungicidal or bactericidal agents. The follicles regenerate after such dosage and the hair grows again.

3. In the treatment of malignant disease higher dosage is given, and it may be close to the maximum that the normal tissues will tolerate without irreparable damage. The whole basis of the radiotherapy of malignant tumours is that there is a difference between the radiosensitivity of many malignant growths and the normal tissues in which they grow. Such malignant lesions of the skin can be destroyed by doses which are not

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sufficient to cause permanent irreparable damage to the skin and subcutaneous tissues. In most cases, however, the dose necessary will cause a marked inflammatory reaction, with subsequent dryness and permanent depilation. The biological reactions involved in the destruction of the tumour cells are of a complicated nature and involve alterations in the molecular structure of the intracellular protoplasm.

A single-dose technique may be used in the treatment of some superficial malignant tumours of limited extent and known radiosensitivity. This is convenient in such cases because it allows the treatment to be completed without numerous attendances. In larger and more infiltrating lesions a safer result with less damage to normal tissues is obtained by spreading the total dose out over a more prolonged period of time. This may be achieved by using a fractionated technique—that is, the total dose is spread over a period of some days or even weeks, and a daily treatment is given, delivering a predetermined fraction of the total on each occasion. When radium is used the same type of effect may be obtained by continuous irradiation with a small quantity of radium, spread over a period of days.

Inflammations and Dermatoses

Before the days of chemotherapy, x rays were used to treat pyogenic infections such as boils and carbuncles, with marked improvement as regards the relief of pain and induration. There is more rapid subsidence and the inflammatory process becomes more circumscribed. Erysipelas also was treated as a routine in some institutions. These are matters of historical interest now, but there is still a useful field for radiotherapy in the treatment of chronic paronychia, which may be resistant even to modern chemotherapy and which can be healed in the great majority of cases by doses of the order of 100 r or less, repeated at weekly intervals for four or five doses.

A variety of the more chronic types of dermatosis are treated in the same way. Patches of neurodermatitis respond well to the same order of dosage, and chronic eczema with lichenification, resistant to other methods of treatment, usually heals after three or four exposures.

X-ray treatment is of real value in many cases of chronic acne vulgaris with induration of the subcutaneous tissues. There is more doubt about its value in acne rosacea, but I believe that here too it has an important place in the skin manifestations, and certainly it is at present the most valuable method of treatment available to promote healing of the corneal infiltrations and to alleviate the distressing symptoms of pain and photophobia.

Lupus Vulgaris.—The value of x-ray therapy in lupus vulgaris has been the subject of considerable discussion. There is no doubt that many cases have healed after repeated doses of the order of 100 r at weekly intervals. In the course of years many patients have received gross overdosage, with the development of telangiectasis, excessive fibrosis, and subsequent carcinomatous degeneration, and there has been a tendency to consider that carcinoma developing on lupus is always the result of the x-ray treatment. There are, however, examples of lupus carcinoma when no x-ray treatment has been given. The excessive scarring occurring in this disease is likely to give rise to carcinoma in the same way as carcinoma may arise in any other scar tissue, particularly the extensive scars from burns. Fortunately there seems to be good reason to expect that newer methods of treatment will be more efficacious and may make x-ray treatment unnecessary in this disease.

Psoriasis.—This was one of the first conditions to be treated by x rays. The lesions, whether on the skin or on the nails, respond well to small doses in most cases, but unfortunately they recur with almost unfailing regularity. The unfortunate patient then, not unnaturally, again seeks

the remedy which has been so successful, and the process is repeated. There have been many instances in which excessive radiation has been given, perhaps by the accumulation of dose over a period of years by a succession of practitioners, with resultant sclerosis and telangiectasis and ultimately the development of malignant disease. It has been truly said, and it particularly applies to x-ray therapy, that volumes have been written not only about the cures for psoriasis but about the cures for the conditions produced by the cures for psoriasis. Of course, it is not always radiotherapy which causes cancer in psoriasis. There are cases of development of malignant disease in the absence of any irradiation, but I believe that psoriasis should be subjected to radiotherapy only in exceptional cases, when patches resistant to other forms of treatment are causing distressing symptoms, or for involvement of the nails.

Pruritus.—The same arguments apply to the treatment of pruritus. In many instances x-ray therapy will immediately cause relief of symptoms, but only too often the condition recurs, and then recourse is had again to the miracle treatment. The dangers of accumulation of dose are enhanced by the fact that the perineum and perianal regions are parts of the body naturally soft and moist, which are particularly sensitive to irradiation, and do not tolerate heavy dosage. It is difficult for the patient to realize the dangers of this apparently simple and rapid method of alleviating his discomfort, and he may go off to another unsuspecting practitioner when the original one refuses further treatment. There have been many real tragedies with extensive necrosis due to such treatment, and I consider that pruritus also should be treated by radiotherapy only in exceptional circumstances when there is a real dermatitis with lichenification, and after due warning to the patient.

Angiomata

The mixed capillary cavernous type of haemangioma, the so-called strawberry naevus, is often treated by irradiation, and the results of such treatment are almost universally satisfactory. These lesions are present at birth or appear shortly afterwards. They may grow with considerable rapidity during the first year of life, causing great alarm to the mother or they may show little progress, becoming actually larger but with an increase in size only proportional to the growth of the child. In some cases there may be no increase in size, and they may begin to regress and disappear completely within a few months without any treatment.

There is a tendency for all of them to regress within a few years, and it is doubtful if any but a small proportion would remain until adult life even without any treatment. There is no doubt that radiotherapy will make them disappear more quickly and more completely, and, apart from the general desirability of curing the deformity as quickly as possible, there are some cases in which treatment is urgently required. An angioma on the lip may interfere with sucking, or one on the eyelid may interfere with the function of the eye. Others may ulcerate and, if situated in or near the napkin area, may become infected.

Two or three suberythral doses of superficial x rays or applications of beta-ray radium plates will ensure gradual regression, and in most cases this will continue until there is no sign of the lesion and the overlying skin will gradually attain practically normal texture. Complete regression with this form of treatment may take a year or two, but it is preferable to any attempt to cause rapid disappearance with larger doses, as they may cause atrophy and scarring of the skin. There have been instances where such larger dosage has been responsible for severe deformity by interference with the growth of a limb or the proper development of the bones of the face or orbit. More deeply seated cavernous haemangiomata may be effectively treated by the implantation of radon seeds with appropriately small dosage, which should be kept to 1,200 r as a maximum.

The use of radiotherapy in these lesions, if properly controlled with suitably small dosage, is in every way preferable

to treatment by carbon dioxide snow, which in most cases leaves an unsightly scar.

The central vein angioma, or spider naevus, is unsuitable for radiotherapy; and the capillary haemangioma, or port-wine stain, commonly occurring on the face and sometimes of considerable extent, also does not respond to this form of treatment. In order to obtain any improvement in the discoloration by the use of x rays or radium it is necessary to give such dosage that there will be some permanent damage to the texture of the skin. The cosmetic result is usually worse than if no treatment had been given except to cover it with make-up, and there is the real danger of severe scarring, necrosis, and even cancer formation in later years.

Thorium X has been used for the treatment of these stains, being contained in a solution which is painted on the surface of the lesion with the object of making use of its alpha rays with their limited power of penetration. Some dermatologists with experience of hundreds of cases so treated consider that a worthwhile improvement can be obtained, but I have not been able to convince myself of any appreciable effect.

Keloid

In the treatment of keloids and hypertrophic scars radiotherapy has an important part to play. When the keloidal scar is recent and still vascular and has not become organized into solid fibrous tissue, marked improvement can be obtained by the application of x rays or of radium two or three times at intervals of a month or six weeks. Each individual dose should be less than that which would cause an erythema, and care must be taken that the total dose is not excessive. There is subjective improvement with lessening of itching, tenderness, and pain, and the scar becomes paler, flatter, softer, and more pliable, so that there is an improvement in the amount of contracture that may be present. If the keloid is old, hard, and avascular it will not respond to radiotherapy. In such cases it should be removed surgically where possible, and the recent scar treated by radiotherapy to prevent recurrence of keloid. X rays are often used as a pre- or post-operative measure to prevent the development of thick and unsightly scars when surgical operations are undertaken in sites where a good cosmetic effect is essential.

Temporary Depilation

Ringworm of the scalp in children was first treated by Freund in 1897. Its success depends on complete temporary epilation of the affected area, which in fact means complete temporary epilation of the whole scalp. In the first years of radiotherapy there were many failures and accidents in the treatment of these children. Insufficient dosage at any point might mean that areas of infected hair remained on the scalp and the whole scalp became reinfected when the new hair grew again. There were cases of permanent epilation and of necrosis of the skin through overdosage, either in large patches or in strips between adjacent x-ray fields. There were also many successful cases. One of my colleagues had his scalp depilated for ringworm by Sir Malcolm Morris about 50 years ago. He has still an excellent head of hair.

In 1907 Kienböck described a method of giving irradiation to the scalp using five points of application. In 1909 Adamson, a British radiologist, described some modifications to this method, and ever since that time the Kienböck-Adamson technique has remained the most frequently used standard technique for irradiating the scalp in cases of ringworm. A four-field method is advocated by Shanks (1931) as a saving in time, but whichever is used the results, in careful hands, are now uniformly good. Ringworm of the scalp has been stamped out except for sporadic cases, and any real complications and sequelae from the treatment are of the greatest rarity.

Sometimes straight hair may grow back in curls after epilation and—much more serious—curly hair may turn straight. This fact has, however, its compensations. It is a well-known result among the coloured population of Washington, D.C., in the United States, and many mothers

will apply irritants to their children's scalps so that they will simulate ringworm, be treated by epilation, and run a chance of getting straight hair.

Temporary epilation may also be necessary for the cure of resistant cases of sycosis barbae.

Malignant Disease

In the treatment of malignant disease of the skin radiotherapy has a role of great importance. In some cases it is the method of choice and should be used as the sole treatment. In some cases it is better to use a combination of radiotherapy and surgery and in others surgical excision alone should be employed.

The choice of method of treatment, the technique, and the dosage will be decided according to the clinical and histological features of each individual case. Radiotherapy may be given by x rays generated at high or low voltage, by surface application of radium, by radium needle implantation, by telurium, or by some radioactive isotope used in any of these ways as a substitute for radium. A single dose, a continuous application, or a fractionated course of treatment may be the technique chosen.

Whatever it may be, it is essential for the curative treatment of malignant disease of the skin, as in cancer of other organs, to give the chosen form of radiotherapy as a single planned course of treatment. There is no place in the attempted cure of cancer for the multiple-small-dose technique. After possible initial regression the tumour becomes progressively more resistant and cannot then be cured even by more adequate dosage.

A second principle is that if failure has occurred after such a planned course of radiotherapy, a second attempt at treatment is unlikely to be successful and runs a risk of producing necrosis. Surgical ablation should then be carried out in the majority of cases, even though it may mean considerable disfigurement by sacrifice of tissue. In some cases of marginal recurrence outside the previously treated area a further course of radiotherapy may be successful, and may be undertaken without serious risk.

Rodent Ulcer

In small and superficial rodent ulcers there is little to choose between the curative results of radiotherapy and surgical excision. Radiotherapy may be chosen because of the better cosmetic effect in some situation, particularly in extensive lesions in which excision would entail a graft to cover the defect.

In superficial cicatrizing growths, which are often of considerable extent before the diagnosis is made, surgery may be impossible or may be practicable only at the expense of great deformity. Radiotherapy may be successful in such cases with only minimal resultant scarring. In some cases in which the eyelids or the conjunctiva is extensively involved the use of a combination of radiotherapy with surgery may be desirable. Preliminary irradiation may allow the surgical excision to be limited to a simple excision of the eyeball, instead of a wide exenteration of the orbit. Earlier, more limited lesions of the eyelids may be treated by irradiation with little scarring or deformity, and without damage to the eye if a contact shield is placed between the lids and the globe or if the beam of radiation can be directed away from the eye by displacing the eyelid during the treatment.

Squamous-cell Carcinoma

Squamous-cell carcinoma of the skin responds as well to radiotherapy as does basal-cell carcinoma. The percentage of cures is lower because the lesions are in general more extensive when they come for treatment, and because a proportion arise in scar tissue with poor blood supply. There are also a number of failures due to the development of glandular metastases. As a general rule involvement of bone or cartilage by direct extension of malignant disease means that the growth is less likely to be cured by irradiation and more likely to undergo necrosis. Careful technique with radiation of hard quality will, however, provide some

successes in these cases, and it is worth while attempting radiotherapy in the first place in cases such as those of the pinna of the ear, where subsequent surgical excision will not have been made more difficult or more extensive if recurrence or necrosis results.

Malignant tumours on the limbs are difficult to treat by irradiation owing to the likelihood of necrosis of underlying bone and tendons. Squamous-cell carcinoma of the lower limb which sometimes arises on the site of long-standing varicose ulceration is often extensive and infiltrating. It is usually best treated by amputation. In the upper limb, however, every effort should be made to conserve the functions of the hand, and success may be achieved even in lesions of great extent by surface application of radium on a moulded appliance over a period of not less than two or three weeks.

Epithelioma of Lip

Epithelioma of the lip may come within the province of the dermatologist. Here too the choice between radiotherapy and surgery must be carefully decided for each individual case. Radiotherapy may be chosen, particularly in growths extending along the lip margin, on account of the excellent cosmetic results. Surgery should be chosen in cases of recurrence after radiotherapy and in advanced cases with deep extension and involvement of bone. Surgery may be necessary for repair of the tissue defect where radiotherapy has successfully dealt with an ulcerating type of lesion.

In tropical and subtropical countries such as Australia or South Africa, where European populations have continuous exposure to hot sunlight, there is a much higher proportion of skin malignant disease than in this country. Radiotherapy is of enormous benefit, and is widely used for the treatment of multiple lesions, either hyperkeratoses which would progress to the development of cancer, or frankly cancerous lesions. There is a place for surgery too in the treatment of these patients with a multiplicity of lesions and the certainty that more will develop. The cosmetic results must be of minor importance, and anyway, in a dry and keratotic skin, the scars of multiple small incisions may not be more unsightly than those of multiple treatments by irradiation. Surgery is generally preferable to irradiation for malignant growths occurring on the trunk. The type of rodent ulcer is often the intradermal and superficial cicatrizing variety; when treated by irradiation they usually leave thin atrophic scars which are easily damaged if rubbed by clothing; the cosmetic effect is not important, and surgical excision is often quicker and easier for the patient than a fractionated course or prolonged continuous applications of radiotherapy.

Although successful results may be anticipated from adequate surgery or adequate radiotherapy of rodent ulcer and squamous cancer of the skin, even early growths which are superficial and apparently innocuous in appearance, if not adequately treated, will recur and they will infiltrate widely, causing destruction of underlying tissues and ultimately the death of the patient. There are also some few of them, with no obvious difference in their clinical appearance, which appear from the onset to be much less amenable to treatment and which, despite wide excision or apparently suitable radiotherapeutic technique, develop rapid and widespread recurrence.

Naevocarcinoma

Malignant melanoma, or naevocarcinoma, is one of the most rapidly developing and deadly forms of malignant disease. It is usually considered to be the supreme example of a radioresistant tumour for which surgery is the sole appropriate treatment. Recent observations have shown that some of these tumours are radiosensitive and that it is advisable to give wide and intense post-operative irradiation after surgical excision.

Reticuloses

The diffuse group of diseases affecting the reticulo-endothelial system, which includes mycosis fungoides, Hodgkin's disease, reticulum-cell sarcoma, lymphosarcoma, and the

leukaemias, have dermatological manifestations, sometimes as the first presenting feature. Radiotherapy is of great value in the treatment of many of these eruptions as well as in the more deeply seated lesions in glands, viscera, and skeleton. They often are very radiosensitive and disappear rapidly with small dosage, but unfortunately they are not permanently arrested, and widespread recurrence almost invariably leads to a fatal termination.

Local Reactions

Often there is misconception about the type of local reaction which occurs after irradiation for the treatment of malignant disease. It may be necessary to give the maximum dose which the normal tissues will tolerate, and this may produce a moist desquamative reaction of the epidermis. It is less frequently seen nowadays, and is avoided whenever possible. It will heal rapidly in 10 to 14 days, leaving a dry, rather inelastic, and hairless skin with some pigmentation, and in individual cases there may be later development of telangiectases. This is the maximum therapeutic reaction which should be produced on the skin and should not be confused with an area of necrosis, the x-ray or radium burn, which is a deeper ulceration involving the dermis or deeper tissues.

Necrosis

Necrosis is the most serious complication of irradiation. It may occur as an immediate sequel to treatment with high dosage, in the form of early or acute necrosis. In such cases, following an early developing erythema which becomes a deep purplish colour, with some oedema of the affected part, the ulceration may extend rapidly, and is associated with severe pain. There is little tendency to heal, because of lack of blood supply, due to endarteritis of the vessels in the affected area. There is always marked secondary infection.

Acute necrosis occurs as the result of some error or accident in technique such as the use of the wrong filter, the overlapping of adjacent fields of irradiation, or some miscalculation or error in measurement of the time for delivering a prescribed dose. It may also occur as the result of lack of appreciation in the prescription of treatment of the dose which some particular area will tolerate. There are individual variations in resistance according to age and certain pathological states: infected tissues necrose more readily; certain parts of the body are more sensitive than others, particularly if bone is close underlying the skin or there is a deficiency of blood supply; the previous application of local irritants may increase sensitivity; and, in particular, previous irradiation renders the tissues more liable to necrosis.

Necrosis may occur when a deliberate risk has had to be taken and heavy dosage has had to be used as the only possible chance of curing the disease. Although necrotic ulceration is often thought to be a sign of inaccurate treatment it is inevitable that occasional instances should occur in the treatment of large numbers of cases of cancer. It may sometimes be the price that has to be paid for the cure of the disease. Necrosis should never occur, and the risk should not be run, when dealing with non-malignant conditions which can be treated by other means.

Necrotic ulceration may occur as a late phenomenon. An area which has been heavily irradiated has some deficiency of blood supply due to increased fibrosis and sclerosis of the blood vessels. Such a volume of tissue may not withstand the effects of trauma occurring at a later date and may break down with the development of ulceration similar to that of acute necrosis. For example, after the treatment of a malignant tumour of the skin excessive exposure to the sun or to frost-bite may precipitate necrosis even many years later. Heavily irradiated bone and cartilage are particularly liable to late necrosis, and the precipitating cause may be some accidental blow or even a local infection of minor degree. Necrosis of the jaw may occur following dental extraction even five and ten years after heavy irradiation for cancer of the tongue or mouth.

Carcinogenesis

Repeated small and suberythematous doses, each of which has no apparent clinical effect, may cause irreparable damage to the skin. The effects come on gradually and may not be seen until years after the irradiation. There is dryness of the skin due to destruction of sweat and sebaceous glands, permanent depilation, and loss of elasticity due to fibrosis of the dermis. There is also a diminution in subcutaneous tissue, and the skin develops a drawn, shiny parchment-like appearance, sometimes with the development of disfiguring telangiectasis. This stage will go on to the development of hyperkeratoses and papillomata; if occurring on the hands, cracks and fissures will occur around the nails, which become ridged and brittle. Eventually cancer will develop with induration of the base of the hyperkeratoses, or by extension of ulceration from the unhealed fissures. This is the type of reaction and sequence of events which occurred in the pioneer radiologists.

In 1904, nearly 20 years before the formation of the British X-ray and Radium Protection Committee, which led the way in setting up safe working conditions, Dr. Cecil Lyster, medical officer in charge of the electric department of the Middlesex Hospital, discussed the loss of sensation in his own fingers after repeated daily exposure, and stated: "It was not until after three months' constant exposure that I noticed my nails were becoming hard and dry with a tendency to split. The hair came off the back of my hands and I soon found the skin, where most exposed to the rays, became dry and scaly." He then used a pair of wash-leather gloves painted with white lead, and his hands improved. His account goes on to describe the ulceration which developed on the back of his fingers following the exposure of his ungloved hand for 20 minutes to x rays in May, 1903. His hands healed on that occasion, but unfortunately he developed cancer of the hands and died 17 years later. He was one of that gallant and unfortunately numerous band of x-ray martyrs who died as the result of changes induced by overexposure to radiation. There were other pioneers, and among them dermatologists, who suffered from the general effects of irradiation and succumbed from aplastic anaemia.

Discrimination in Use of Radiotherapy

These local and general reactions and sequelae, occurring sometimes 10 and 20 years after multiple treatments or frequent exposures, have drawn attention to the urgent necessity for discrimination in the choice of the condition for which radiotherapy should be used. I consider that as a principle it should not be used in any non-malignant condition for which a simpler and safer method of treatment will give equal chances of success.

Warts.—The place of radiotherapy in the treatment of warts is a question on which there is by no means general agreement. Many of them will disappear after adequate irradiation, but in most instances single warts of long standing, particularly those around and under the finger-nails, need a dose to the small area involved which is sufficient to produce a sharp erythema and perhaps desquamation. Warts on the plantar surface of the foot are a special problem; they can frequently be treated with complete success by a single dose of x rays or a single treatment by radium. This is particularly true of the infective plantar warts of children. The sole of the foot, in common with the palms of the hands and the perineum, is one of the most dangerous areas to irradiate. It is very liable to trauma, and necrosis may occur after heavy dosage. Sometimes warts have failed to disappear or have recurred and have been given a further dose, perhaps by another practitioner. In some cases callosities caused by faulty weight distribution have been treated as plantar warts and have inevitably recurred. Whatever the reasons, there have been numerous cases of severe and crippling necrosis following the treatment of warts, and I consider that, even though the majority can be treated easily and successfully without accident, it is wiser to withhold

irradiation and to treat them all by safer methods such as surgical excision.

Cosmetic Treatments.—The use of radiotherapy for cosmetic reasons such as the removal of superfluous hair should be condemned, as it has been the cause of many real tragedies. Permanent depilation cannot be attained without running the risk of later skin changes, with much disfigurement and subsequent cancer formation. The permanent reduction in secretion of sweat can also be attained only with great risk, and hyperidrosis should be treated by irradiation only in exceptional cases. The risks inherent in the treatment of pruritus and psoriasis have already been discussed.

The type of skin cancer which occurs as the result of irradiation is usually squamous-cell epithelioma, but rodent ulcers have occurred and sarcoma has also been described.

Radiotherapist and Dermatologist

The advent of the radiotherapist has created some problems and some difficulties in deciding the exact place of the dermatologist and of the radiotherapist in the radiotherapy of dermatological conditions. These problems must be solved, and are being solved, by mutual good will and understanding, because both have some essential contribution to make. X-ray therapy is for many dermatologists such an important part of their work that they have installed their own x-ray therapy plants as a necessary adjunct to their dermatological practices. They have become accustomed to treating their patients with standardized techniques and have largely eliminated the dangers and accidents by using very small doses, which are all that is necessary for the majority of patients they treat. Naturally such experienced dermatologists consider that there is no necessity for the help of the radiotherapist and that they can be self-sufficient. On the other hand, there is a tendency for the radiotherapist to consider that all cases of malignant disease of the skin should undoubtedly be treated by him and should be in his sole care.

I do not think that these arrangements are satisfactory and in the best interests of the patient. Radiotherapy of all conditions is best conducted, and the best results will be obtained, if there is constant and close collaboration between the radiotherapist and his colleagues in other clinical specialties. In dermatological radiotherapy, collaboration between dermatologist and radiotherapist will bring the best results so far as the patient is concerned.

Apart from such technical questions as ensuring accuracy by proper calibration and measurement of dose, of ensuring homogeneity of irradiation over the field irradiated, and apart from questions of protection of patient and personnel and adequate maintenance of plant, the radiotherapist can bring his experience in the irradiation of other conditions. The use of this knowledge, added to the specialized clinical experience of the dermatologist, is most likely to ensure progress in this branch of therapy.

Such collaboration is also essential in the development of the proper use to be made of new methods of irradiation and new technical possibilities that are now available. The whole field of use of radioactive isotopes must be explored. Many of these are suitable for dermatological use, with greater convenience and safety than the established methods of irradiation, and can provide a variety of new techniques. There is also an urgent need for more knowledge of the biological effects produced by radiation in many of the conditions which are treated.

The period of 30 years since the death of Sir Malcolm Morris has seen many changes and much progress in radiotherapy in relation to dermatology. We are now in a period of intense activity and discovery, but there is still much to be done.

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