Neoplasms of the skin present fewer technical difficulties in treatment than those more deeply situated. In the average early case of skin cancer, good results are obtainable with a considerable variety of methods. However, should the lesion be extensive, deeply infiltrating, situated over an irregular contour or over radiosensitive or vital structures, one particular method may offer great advantages over all others. The treatment of these superficial lesions, therefore, offers an excellent opportunity for the clinician to familiarize himself with the effects and advantages of the various technical methods and with some of the physical principles governing radiation therapy.

**Physical Principles**

Radiation in sufficient quantity to destroy most neoplastic tissue is always injurious to normal tissue. In radiation therapy we must accept this fact and, as far as possible, limit the degree and extent of this injurious effect to the volume of tissue occupied by the neoplasm. Limitation of radiation effect may be obtained to a certain degree by variations in methods of application. The sources of radiation available are radium and x-rays. The different physical factors governing the use of these agents, which may be varied for this purpose are: (1) area of radiating surface, or size of skin portal, (2) distance, (3) filtration, (4) for x-rays, voltage, and (5) for radium, the use of interstitial instead of external application.

*The area of the radiating surface of an applicator, or the size of the skin portal, should be the same as or only slightly larger than the superficial lesion to be irradiated. This principle is, we believe, generally recognized and requires no discussion.*

*Distance:* The intensity of radiation from a point source varies inversely as the square of the distance. When the source is not a point, this law is modified somewhat. The distribution of radiation in the tissues, therefore, varies with the distance of the source from the skin. This fact is recognized and made use of in the irradiation of deep-seated tumors, at relatively long distances.

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1 Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30-Dec. 4, 1931.
In superficial treatments, however, particularly with radium applicators at short distances (0 to 2 cm.), it is often lost sight of.

In Figure 1, s represents the skin surface of a superficial lesion with a radium applicator and underlying distance block in place, the radium being at a distance \( d \) from the skin. The superficial lesion infiltrates down to the depth of \( a \). With this hypothetical set-up, let us assume that the best possible permanent cosmetic and functional result has been obtained. The reasons for this are as follows. With the applicator dose given, the tissue dose at the depths of the tumor (level \( a \)) was just lethal to the neoplasm, the larger dose at \( s \) was one from which the skin would readily heal, and the lesser dose between \( a \) and \( b \) was not sufficient to interfere seriously with the blood supply of the subcutaneous tissues.

![Diagram](image)

**Fig. 1**

An equally good result would not have been possible with this applicator at either a greater or less distance. At greater distances than \( d \) the tissue doses at the skin surface and level \( a \) would have been more nearly equal, but larger doses than with the previous arrangement would have been delivered in the underlying tissue between the levels \( a \) and \( b \), producing a greater injurious effect at this depth. Such deep effects on the vascular supply of the subcutaneous tissues account for delayed healing and later necrosis in many cases. On the other hand, at distances less than \( d \) the difference between the tissue doses on the skin surface and at a depth \( a \) is greater. Therefore, in order to obtain a lethal dose at level \( a \), a greater dose than in the first case must be delivered on the skin, resulting in slower healing and a less satisfactory scar.

An understanding of the above principle will at once demonstrate the ineffectiveness of treating growths a centimeter or more in thickness by contact or very short distance applications, though these methods are the most effective for more superficial lesions. For lesions 1 cm. or more in thickness, the applicator should be at a greater distance, interstitial implants should be employed, or,
if the tumor projects above the surface of the skin, irradiation may be preceded by removal by endothermy of a portion down to the skin level.

Filtration: The radiations from a radio-active source, or from an x-ray tube, contain a large proportion of rays which are very "soft," that is, easily absorbed. If such rays fall on the skin, they are absorbed in the first few millimeters of tissue. If any material or "filter" is placed in the path of the rays, the softest ones will be absorbed in it and will not pass through. The average of the remaining beam will then be harder than that of the initial beam. As the filter is increased, the hardness or penetration of the transmitted beam also increases. Obviously, for deep therapy a considerable filter is desirable.

It has often been erroneously stated in regard to highly filtered x-rays or gamma rays that these are not harmful to normal tissues because the "caustic" softer radiation has been removed. All radiation is "caustic" or injurious to living tissue if a sufficient quantity is used. The proportion of softer radiation is always greater in an unfiltered beam of roentgen or radium rays, and if such a beam is used, this soft radiation, being absorbed in the superficial tissues, produces an intense local effect. While such a superficial effect is being produced, the accompanying hard x-rays or gamma rays are of such slight intensity in comparison that little deep effect is produced. For these reasons soft radiation has gained an unmerited reputation of being more harmful to normal tissues than harder radiation. As a matter of fact, there is no definite evidence to prove that the relative effects on normal and neoplastic tissue differ for different types of radiations.

For treatment of superficial lesions, where it is desirable that the effect shall be confined to the first few millimeters of tissue, the soft rays from either radium or x-rays are among the most valuable agents. Technical details regarding their use will be given later.

Voltage: Increasing the voltage across an x-ray tube increases the proportion of penetrating radiation in the beam. The lower the voltage, the greater the percentage of radiation which will be absorbed in the first layers of tissue. Therefore, for superficial effects it is evidently desirable to use radiation generated at relatively low voltages.

Interstitial Irradiation: By interstitial irradiation the closest approximation to the ideal localized effect can be obtained. By this means alone can one be assured that a tumor mass situated below normal tissues receives more irradiation than any adjacent normal tissue. In many clinics, needles of the element or radon are used, but we prefer our standard interstitial applicator, the
gold seed (4 mm. long, 0.7 mm. diameter, 0.3 mm. gold filter). For practical purposes its use is limited to certain types of lesions, which are discussed later under the proper heading.

**TECHNICAL METHODS**

The best results with radiation therapy in skin cancer are obtained by the massive dose method, *i.e.* one sufficient to destroy entirely the lesion treated. In some groups, as pharyngeal tumors, massive doses of external irradiation are best tolerated by dividing the dose, but these divided doses should all be delivered within the period of acute radiation reaction. In the average cancer of the skin, the dose, however large, should be administered in one sitting. If this dose must be repeated, or supplemented, the original treatment must be classed as a partial failure.

Skin lesions are treated by means of the following sources of radiation, the order in which they are given, however, not being indicative of the relative frequency of their use (Fig. 2).

**Distance applicators**
1. X-rays, 140 kv., 4 or 5 ma., 1 mm. Al or no filter, 20 to 25 cm. distance
2. Radon tray, 20 sq. cm. area, 3 cm. distance, 3 mm. brass filter (equivalent)
3. Radon plaques, 1 cm. distance, 3 mm. brass filter (equivalent)
   (a) Square plaque, area 1.8 \times 1.8 cm.
   (b) Long plaque, area 1.7 \times 2.7 cm.
   (c) Round plaque, diameter 4 cm.

**Intermediate applicators**
4. Platinum gold radon tubes, 1.6 cm. long, 1.5 mm. diameter, \( \frac{1}{2} \) mm. wall thickness, 2 mm. brass filter (equivalent)
5. Bulb, no filter

**Surface applicators**
6. Gold seeds, 0.3 mm. filter

Our armamentarium for the treatment of superficial lesions is thus quite extensive. Each one of these methods has its peculiar advantages in certain types of growths. Our most commonly used applicators for the treatment of skin lesions are radon plaques, after which the relative frequency of use is in about the following order: unfiltered radon bulb, gold seeds, x-rays, surface contact applicators, and radon tray.

**Radon Plaques at 1 cm. Distance:** We find these applicators most generally indicated for the average small skin lesion varying from 0.5 to 3.0 cm. in diameter. The principle employed is about the same as that followed by most Continental radiologists in the use of wax or Columbia paste moulages made especially to fit each case and embedded with filtered radon capsules at a distance of about 1 cm. We find, however, that with a set of three or four plaques of various shapes and diameters it is possible to fit any
of the smaller superficial growths of the size suited to treatment by filtered radon at short distances, and that much time and expense is thereby saved in the preparation of the applicators. The clinician becomes familiar with the effects of various doses with these specific applicators, and the desired effect can be better regulated. The applicators consist of shallow, box-shaped containers made of sheet brass 1 mm. in thickness, in which are placed "platinum tubes" containing radon (Fig. 2, a, b and c). The total filter is the equivalent of 3 mm. brass, and application is always at a distance of 1 cm.

**Fig. 2. Radium Applicators for the Treatment of Superficial Lesions**


These applicators are eminently satisfactory for lesions of about the same or slightly greater diameter than that of the plaque and not more than 3 to 4 millimeters thick. (Figs. 3-5). The dose is diffuse through a small shallow volume. If the growth is thicker and protrudes markedly above the surface of the skin, we advise the removal of the projecting portion down to the level of the skin by endothermy before application of the plaque. If the growth infiltrates deeply below the surface of the skin, treatment is better given at greater distance or by interstitial irradiation. The doses for basal-cell carcinoma of not more than 5 mm. thickness are as follows:

- Square plaque, 1000 mc. hours.
- Long plaque, 1100 mc. hours.
- Round plaque, 1500 mc. hours.
**Gold Seeds:** Gold seeds (Fig. 2, g) are particularly indicated in the following types of growths.

(1) *Small lesions (1 cm. or less) on a surface of irregular contour* such as the inner canthus of the eye (Fig. 6), the alae nasae, or the ear. An irregular contour does not lend itself well to the use of a fixed applicator and underlying block. The depths of a depression will be at much greater distance than the elevated portions and the radiation effect therefore very unevenly distributed over various parts of the lesion. Often in such a case neighboring normal parts will be nearer the radioactive source than the lesion itself.

(2) *Small lesions near sensitive structures* such as the palpebral margins of the eyelids (Fig. 7). The orbit itself is not particularly sensitive to irradiation except for the occurrence of late radiation cataract. The risk is undoubtedly less if the lens is protected by limitation of the dose to the lesion itself. Both the ocular and palpebral conjunctivae are very radiosensitive. An acute conjunctival reaction is quite painful and may result in permanent epilation of the eyelashes and long-continued dryness and chronic irritation of the conjunctival surfaces. Many of these undesirable sequelae may be greatly lessened if not entirely avoided.
Carcinoma of the Skin of the Cheek of Twenty Years' Duration, Recurrent After Operation Thirteen Years Before

The primary lesion measured 2.5 × 1.5 cm. Biopsy report was "basal-cell carcinoma." Treatment was by the long plaque—1200 millicurie hours at 1 cm., filter 3 mm. brass.

Carcinoma of the Skin of the Cheek of Two and a Half Years' Duration

The primary lesion was 3 cm. in diameter. Biopsy report was "basal-cell carcinoma." Treatment was by the round plaque—1500 millicurie hours at 1 cm., filter 2 mm. brass.
FIG. 6. CARCINOMA OF THE EYELID OF EIGHT YEARS' DURATION

The primary lesion was 1 x 1.5 cm. in diameter and invaded the eyelid near the inner canthus. Biopsy report was "basal-cell carcinoma." Treatment was by 3 gold seeds of 1.7 millieuries inserted into and below the lesion.

FIG. 7. CARCINOMA OF THE EYELID OF EIGHT MONTHS' DURATION

The primary lesion measured 0.5 cm. in diameter, and invaded the palpebral margin. Biopsy report was "basal-cell carcinoma." Treatment was by one gold seed of 2 millieuries inserted into and under the lesion.
by the use of interstitial implants in the eyelids and in or near the canthi of the eyes. Fig. 8 illustrates diagrammatically how the sensitive surrounding structures may be protected while administering a given dose within a limited volume of tumor tissue near the orbit.

(3) **Deeply infiltrating solid basal-cell or squamous carcinomas** such as are commonly found in recurrences following surgical removal do not respond favorably to external irradiation unless the dose be pushed beyond a point which is justified from the standpoint of recovery and healing of adjacent normal tissues. The excellent result obtained by external irradiation in the average skin cancer depends largely on the fact that the lesion is superficial and that it does not infiltrate deeply. Recurrences after surgical removal commonly infiltrate deeply because of the infolding during closure of the surgical wound; whereas the original lesion may not have infiltrated to a depth of more than 2 or 3 mm., the first focus of the recurrence may be at a depth of 1 cm. or more. In this type of recurrent lesion or in an untreated lesion which infiltrates deeply, we find interstitial implantation indispensable (Fig. 9). The dosage is calculated on the basis of a three-dimensional tumor rather than a flat surface.

(4) **Carcinoma of the lip**, if superficial, responds with excellent cosmetic results to cross-firing contact application by a technic described below. However, if the growth infiltrates to a depth
beyond 2 to 3 mm., it is best to supplement such contact irradiation by a moderate dose of gold seeds into the base of the tumor (Fig. 10). In growths of the lip of greater bulk or involving the labial commissure, interstitial irradiation is the method of choice.

**Gold-platinum Tubes:** Surface contact application is most commonly used by us for the treatment of superficial carcinoma of the lip (Fig. 11). For practical reasons it is not advisable to attempt irradiation of lip cancer at distances of 1 cm. Our gold-platinum tubes (Fig. 2, h) are held in place in a mold of dental compound (Fig. 2, f), so that the lip and lesion are irradiated from three sides. By this cross-firing a considerable dose can be delivered to the base of the tumor. The dosage in such applications is calculated in millicurie hours per square centimeter of surface irradiated, and varies from 80 to 100, depending on its area. The larger the area irradiated the less the dose which should be given per square centimeter, because of the overlapping of effect from neighboring tubes. If the lesions are quite thick (4 to 5 mm. or more), seeds are added to the base.

For flat lesions of the skin, of not more than 1 mm. in thickness and not over 5 to 6 mm. in diameter, it is often of advantage to apply one platinum tube directly in contact with the lesion (Fig. 12). This may be conveniently held in place by a small piece of
dental compound or even by adhesive tape. The effect is more localized and superficial than with the plaques, and often the cosmetic result is better.

**Fig. 10. Deeply Infiltrating Carcinoma of the Lip**

The primary lesion was 2 cm. in diameter, infiltrating the entire thickness of the lower lip to a depth of about 2 cm. Biopsy report was "squamous carcinoma." Treatment was by contact application—radon tubes in a dental compound mold, 75 millicurie hours per square centimeter, 5 sq. cm. treated. One gold seed of 2.0 millicuries was inserted into the center of the lesion. There was no evidence of disease five years later.

**Fig. 11. Superficial Carcinoma of the Lip of Three Months' Duration**

The primary lesion was 1 x 0.5 cm. Biopsy report was "squamous carcinoma, Grade II." Treatment was by contact application—radon tubes in dental compound mold, 90 millicuries per square centimeter, 5 sq. cm. treated.

Another area where one tube may be used is in the crease at the junction of the ala nasa with the cheek. Superficial lesions at this site should always be treated either by contact applications
or implantation, in order to preserve the cosmetic appearance of the neighboring parts.

**Bulb:** This is one of our most useful applicators for the treatment of very small, early basal-cell cancers and pre-cancerous keratoses (Fig. 13). It is made up once in three weeks at the Memorial Hospital, and one clinician with sufficient clerical assistance is able to treat as many as 40 to 50 cases (many with multiple lesions) in a period of about two hours. The majority of such lesions may be treated equally as successfully by soft x-rays or by contact application, but it will be readily appreciated that the expense in time and labor in treating perhaps 75 to 100 separate small lesions by any other method would be prohibitive. The bulb is also an excellent means for the treatment of benign epithelial warts anywhere about the skin. In such cases the horny non-vascular portion of the wart should be pared or curetted off so that the applicator comes as close as possible to the growing base.

This applicator consists of a small glass bulb about 5 mm. in diameter, which contains radon. Usually, when it is first made up, the strength is between 300 and 500 millicuries. This glass

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**Fig. 12. Carcinoma of the Skin of the Cheek of Three Years' Duration**

The primary lesion was 3 mm. in diameter and 1 mm. in thickness. Biopsy report was "basal-cell carcinoma." Treatment was by contact application—1 platinum tube, 100 millicurie hours, filter 0.5 mm. platinum.
bulb is held in a small, cup-shaped container attached to a wire handle (Fig. 2, e). The glass bulb is held directly in contact with the lesion, and there is no filter except the intervening glass. The dose is calculated in "millicurie minutes." The average dose for small lesions is from 250 to 400 millicurie minutes, so that one application lasts about one to two minutes. No other applicator would permit the treatment of cases in such rapid succession.

Since there is no filter and the applicator is held in direct contact with the lesion, the effect is very superficial and an intense dose can be given to the lesion without a deep effect. Beta radiation is the chief component in the action of this applicator. It should not be used for lesions much more than 1 mm. in thickness.

X-rays: From the standpoint of cost, x-rays are the most economical source of radiant energy, and if radium is not available, a fair degree of success may be obtained by the proper use of this agent in a considerable variety of superficial lesions. We find, however, that for most smaller lesions the proper shielding of surrounding normal parts and setting up the machine in the correct relation to the patient are much more inconvenient and time-consuming than the use of the radium technic outlined above. X-rays are not efficient for the treatment of deeply infiltrating lesions of the skin, such as postoperative recurrences, or for growths of extremely irregular contour. We confine the use of x-rays almost entirely to basal-cell carcinomas of large surface

![Fig. 13. Multiple Seborrheic and Precancerous Keratoses of the Face](image-url)

The patient has received numerous treatments by the unfiltered radon bulb to various areas of the face. Although the treated areas regress, other keratoses appear and require treatment at about three-month intervals.
area (6 to 20 cm.), where the large field makes it difficult to apply radium in uniform dosage (Fig. 14).

The desired superficial effect is obtained by the use of low voltages (140 kv.) and a filter of 1 mm. of aluminum. If an even more superficial effect is desired, the filter may be entirely omitted. We use the shortest possible safe distance (20 cm.) and administer at one sitting from 4 to 6 skin erythema doses (2500 to 3500 r units). Such doses are effective for basal-cell carcinomas up to 1 cm. in thickness. Widespread, advanced lesions commonly pro-

![Fig. 14. Carcinoma of the Skin of the Temple of Six Years' Duration](image)

A biopsy report was "basal-cell epithelioma, adenoid type." The primary lesion (A) was 15 cm. in diameter and 2.5 cm. in thickness. The treatment consisted of removal of the irregular portions of the tumor by thermocautery (B), followed immediately by x-radiation, 3600 r units (140 kv., 1 mm. Al filter, 25 cm. target skin distance, 5 mm., 25 minutes). The left orbit was removed by cautery one month later because of infection. At the present time there is no evidence of disease, although the ulceration is not completely healed (C).

ject from the surface of the skin 2 to 3 cm. from the base. In such cases, the projecting portions should be removed by actual cauterity or endothermy before treatment, so as to permit sufficient penetration to the base of the tumor. The surrounding normal parts should be protected by an accurately fitted shield of lead foil, 0.5 to 1.0 mm. in thickness. This should be cut and fitted to each lesion so that it protects normal skin up to 5 mm. from the border of the lesion.

**Radon Tray:** The radon tray (Fig. 2, d) of 20 sq. cm. surface, filter 3 mm. brass, distance 3 cm., is sometimes useful for the treatment of deeply infiltrating, widespread growths, especially those of squamous or adenoid character, which are apt to be radio-resistant (Fig. 15). The dose in such cases is from 4000 to 6000 millicurie hours. Basal-cell carcinoma, being radiosensitive, can perhaps better be dealt with by x-rays.
Such applicators as gold seeds and the radon bulb can be available only in well organized clinics possessing considerable quantities of radium. With the exception of these, all the various applicators and technics described above may be employed, with a few necessary modifications, by any radiologist having access to a low-voltage x-ray machine and a fair quantity of radium in the form of needles. Element needles, if of small caliber, may be substituted for gold seeds to a limited extent. We know of several isolated radiologists who have constructed plaques to contain an odd assortment of element needles. The effects of such applicators of fixed form, size, and distance may be accurately gauged after repeated experiences. The construction of applicators to fit each lesion, by the use of Columbia paste or wax moulages, is time-consuming but practicable, provided the radiologist is thoroughly familiar with necessary physical calculations to determine the dose in each instance. The latter procedure is quite widely followed by Continental radiologists, but has never been a common practice in America.

Fig. 15. Adenoid Cystic Basal-cell Carcinoma of the Skin of the Temple of Seven Years' Duration

The primary lesion was 10 cm. in diameter, invading the outer canthus of the left eye. Biopsy report was "basal-cell epithelioma, adenoid type."

The treatment was chiefly by radium tray, 2 applications of 3500 millicuries each at 3 cm., 2 mm. brass filter at anterior and posterior borders of lesion. Two months later 2 plaques were applied to the extension of the disease at the borders. During the next three months small remaining nodules were treated by single gold implants. Later the left orbit was removed by cautery because of infection. The patient was free of disease after three and a half years.
Unfiltered soft x-rays have about the same superficial effect as the radon bulb, and to some extent may be used for the same purpose, provided accurately fitted protective shielding is employed.

In our experience in a large cancer clinic, radiation failures as seen on admission are mainly due to two causes: first, the use of an applicator wholly unsuited to the lesion in question; secondly, the use of improper, usually inadequate, dosage. Many skin lesions have been subjected to repeated irradiations over a period of months or even years with little radiation effect. No one should attempt radiation therapy, even of basal-cell carcinoma, unless he has the experience and courage to apply at one sitting a sufficient quantity to cause complete regression.

SUMMARY

The general principles of radiation therapy in the treatment of superficial lesions are discussed. Several factors pertaining to radiating sources may be varied to produce desired superficial effects. The reasons for such variations in technic are outlined. The applicators employed for superficial therapy at Memorial Hospital are described and the indications for the use of each is given. Methods of applying the principles of such technic with more limited facilities are suggested.

The author wishes to acknowledge his indebtedness to Edith H. Quimby of the Department of Biophysics for her assistance in securing the physical data for this paper.

DISCUSSION

Dr. LeRoy Sante (St. Louis, Mo.): In our search for new methods of procedure and new technic, we are often likely to neglect the development of those we already have. A paper such as the one just given will do us much more good than a theoretic search into the unknown.

The success or failure, it seems to me, of radiotherapy depends upon the infinite detail with which it is undertaken. I have had an opportunity to observe some of Dr. Martin's work at Memorial Hospital, and I recall one of his cases which illustrates this point very well.

A man had a large growth on his scalp, which Dr. Martin removed with paste, if I remember correctly, in order not to damage the underlying bone with radiation. After the growth was destroyed numerous holes were drilled through the outer table of the skull in order to provide granulation upon which the scalp could grow. Plenty of radium was available yet he chose to use this method.

I think if we all follow this procedure of studying the needs of the individual case and of utilizing the method that we think best suited to the case in hand, our results will be much better. Do not be wedded to any special method, radium, the cautery, or surgery. Use the method best suited to the individual case.

I noted Dr. Martin's reference to the use of relatively unfiltered radiation in the treatment of large surface growths. I think there is no doubt that in these cases it gives very gratifying results in many instances. If there is a growth right
on the surface, the growth can be used as a filter, and measurements taken from the theoretic base of the tumor. In such cases use relatively little or no filtration. Let the tissue represent the filter, and I think you can get some very gratifying results.

Here and there, of course, tumors will be encountered that are relatively radio-resistant, and will not succumb to the effects of radiation no matter how much is applied, short of absolute destruction of the normal tissue. With this "unfiltered" method, however, the chances are better.

I was interested in the use of gold seeds in tumors about the eyelid. We have used surface applications, with the eye shield to protect the eyeball. The metal eye shield must be dropped in paraffine to avoid secondary radiation effects on the conjunctiva. I have seen a number of cases of conjunctivitis following radiation of the eye. We have had good cosmetic results without retraction of scars. We have treated lesions that have extended across the eyeball, confining our radiation as closely as possible to the field of involvement.

I would like to ask whether Dr. Martin has made the same observation as Dr. Withers, that excessive radiation to the eyeball sometimes is followed by acute glaucoma. Dr. Withers has seen it, while I have not. We have always used the gold shield for a filter.

Dr. Martin: The practice of using gold seeds in the eyelids is, with us, a development of the last three or four years. Previous to that time, we treated most eyelid growths with our plaques at a distance of 1 cm., using lead shields to protect the eyeball.

Dr. Sante: Do you make the seeds any smaller?

Dr. Martin: That depends on the size of the lesion. Some very small lesions may be treated by seeds as weak as 1 mc. each.

Dr. Sante: I did not mean any smaller in strength, but in size.

Dr. Martin: The seeds are not smaller in size, but are of the standard size. We insert them just under the surface of the lesion so that they will stay for from a week to ten days. In some cases they are extruded; in other cases the patient will come back three months later or more and one can see the seed lying just under the surface of the scar. The shields, whether of gold or lead, are put just inside the eyelid in the conjunctival sac to protect the eyeball. The eyeball itself is not particularly sensitive, except for the cornea and conjunctiva. Cataract sometimes occurs as a late development.

Dr. Sante: Have you seen acute glaucoma?

Dr. Martin: We have never seen acute glaucoma after such treatment. We always use protective shields in the conjunctival sac with the plaques. The difficulty, however, is that such shields protect only the eyeball and not the eyelid. We sometimes get severe conjunctivitis, which, however, always clears up, but is followed by long continued dryness and chronic conjunctival irritation. Epilation of the eyelashes may occur. I believe this is permanent if it is caused by irradiation. For that reason alone, in order to save the eyelashes, there is a great advantage in using seeds to deliver a very concentrated localized effect.