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NEW YORK

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Skin Diseases

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THE ROENTGEN RAY IN THE TREATMENT OF SKIN DISEASES *

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The honor of opening the discussion on the roentgen ray before this association is one that is greatly appreciated.

Conrad Roentgen made his great discovery in 1895. That this discovery has been of inestimable value to medicine and surgery, there can be no doubt. That it has been of the greatest value to dermatology in particular, I shall try to substantiate.

The early therapeutic results obtained by the use of the roentgen ray were hailed with enthusiasm. It gradually became apparent, however, that this new agent was by no means devoid of danger. Its indiscriminate use caused many disastrous results, and its reputation suffered accordingly. Since the introduction of modern apparatus and technic and especially during the past few years, a renewed interest has been aroused in the use of this notable remedy.

The early results of roentgenotherapy were unsatisfactory because of the inability with the available apparatus (gas tubes, static machines and coils) to measure dosage safely. Of the different methods of direct measurement which were later evolved, probably none has been of greater practical importance than the pastilles of platino-cyanid of barium, introduced by Sabouraud and Noiré. The original purpose of these pastilles was to measure the epilating dose in the treatment of ringworm of the scalp. In this regard the simple radiometer of Sabouraud and Noiré was a success. It was not useful for general purposes, and it did not possess a sliding scale to record fractional doses. This need was soon met by various radiometers, notably those of Holzknecht, Hampson and Corbett, which have been used extensively, particularly in Europe. Other means of directly measuring roentgen rays are furnished by photographic and ionization radiometers.

In spite of their popularity, the pastilles mentioned have certain disadvantages. It is difficult for many to learn to "read" them accurately, and they introduce the uncertain element of personal equation. Furthermore, in this country, at least, it has not been easy to obtain pastilles of a reliable quality.

The introduction by Coolidge of the tube which bears his name and the interrupterless transformer by Snook form the basis of enormous strides in roentgenotherapy. With this modern apparatus,

* Read at the Forty-Sixth Annual Meeting of the American Dermatological Association, Ann Arbor, Mich., June 7-9, 1923.

it is now possible to dispense with pastilles and measure the dosage of roentgen ray by indirect means, with considerable accuracy (even greater than with pastilles). Such indirect (electrical) measurement of dosage is obtained by certain combinations of four factors including milliamperage, spark gap, time and distance (from anode to skin). Remer and Witherbee¹ were able to establish a set of such factors for both filtered and unfiltered radiation, which have stood the practical tests of efficiency and safety in the hands of many. By means of arithmetical formulas, the different factors can be changed to suit the convenience of the operator.

To obtain what Remer and Witherbee have designated as one skin unit (a quantity of roentgen ray which will cause a temporary epilation of the scalp), I have used for routine work the following factors: two milliamperes, 6 inch (15.24 cm) spark gap, three minutes, 8 inch (20.32 cm.) distance (anode to skin). One-half skin unit was produced in one and one-half minutes and one-fourth skin unit in forty-five seconds, the other three factors remaining the same. When it was desired to shorten the time, one skin unit was obtained by using 3 milliamperes, 6 inch spark gap, one minute and nineteen seconds and 6½ inch distance. The foregoing factors refer solely to unfiltered irradiation. To obtain what has been called one "filtered unit," the following factors (from Remer and Witherbee's formula) were used: five milliamperes, 9 inch (22.86 cm.) spark gap, two minutes and thirty-four seconds, 10 inch (25.4 cm.) distance (anode to skin). For two filtered units an exposure of seven minutes was given, the other factors remaining the same. The terms skin unit and filtered unit, as described above, will be used in this paper to indicate dosage.

A method has been devised by Kingery² for maintaining maximum cumulative effects (saturation) of roentgen ray in the tissues. While of great interest and full of promise, this work has not to my knowledge been corroborated.

While a lengthy discussion of technical details is not within the province of this paper, a few words in this connection may not be amiss. The opinion is held by some that the administration of roentgen-

1. For a discussion of the subject of indirect measurement by electrical methods the reader is referred to MacKee's comprehensive book on "X-rays and Radium Treatment of Diseases of the Skin," Philadelphia, Lea & Febiger, 1921. Remer, J., and Witherbee, W. D.: The Action of X-Rays on Plate, Pastille and Skin, *Am. J. Roentgenol.* **4**:303 (June) 1917. MacKee, G. M.: Arithmetical Computation of Roentgen Ray Dosage, *J. Cutan. Dis.* **37**:783 (Dec.) 1919. Witherbee, W. D., and Remer, J.: A Practical Method of Roentgen Ray Dosage Without the Aid of a Radiometer, *Arch. Dermat. & Syph.* **1**:558 (May) 1920.

2. Kingery, L. B.: Saturation in Roentgen Therapy. Its Estimation and Maintenance, *Arch. Dermat. & Syph.* **1**:423 (April) 1920.

ray treatment should be entrusted only to a graduate physician. Many will agree with me, however, that such work, under proper supervision can be safely performed by lay technicians. While giving treatment, my assistants are instructed to keep one hand on the filament control and the other on the high tension switch, closely watching the patient through the lead glass window. It is not safe, in my opinion, for one person to operate two machines simultaneously. I also feel that it is highly important to have two milliamperemeters, one to act as a check on the other.

In the treatment of superficial conditions, with the exception of malignant disease, every precaution should be taken to avoid an erythema, involving as it does the possibility of future damage to the skin. The appearance of pigmentation in diffuse areas or in the form of freckles is a different matter and need not occasion alarm. To lessen the danger of erythema it is important to avoid the use of strong irritants on the skin within one or preferably two weeks, either before or after the treatment. It is also inadvisable to irradiate a surface which is covered with ointments or lotions containing metallic substances, such as zinc oxid. Such substances may, as Reed³ says "act as a barrier to the rays, or their secondary radiations may greatly intensify the action of the primary rays."

In regard to the question of filtered versus unfiltered irradiation, there can be no doubt about the advisability of using the former in deep-seated subcutaneous conditions. For superficial diseases of the skin the two methods are probably equally efficient. If it is admitted that unfiltered irradiation can be safely administered with modern technic, it has a great advantage over filtered irradiation in that it requires much less time for its administration. When large numbers of patients are treated, this is an advantage of considerable importance. Even the supposedly safer method of filtration has the potential danger of failure to place the filter in position. Such a mistake with its disastrous possibilities has happened to experienced roentgenologists.

In the hands of a reasonably intelligent and conscientious operator, using modern methods of treatment, the dangers of the roentgen ray have been reduced to a minimum. In the hands of a careless or ignorant operator the roentgen ray is of course capable of causing great damage. The same could be said, however, of the surgeon's knife or certain poisonous drugs. The results of MacKee's large experience as recorded in his recent book would seem to be sufficient proof of the safety of modern indirect methods of measurement. My own experience as well as that of others substantiates this opinion. During the

3. Reed, E. W.: X-Rays in Diseases of the Skin, Brit. M. J. 2:559 (Sept. 23) 1922.

past seven and a half years in which time I have used measured technic I have given thousands of roentgen-ray treatments without inflicting any serious injury. In a few cases there has been a slight amount of telangiectasia.

The modern indirect measurement as used at present by many of my colleagues in this country is not only safe and efficient, but also is not difficult for a beginner to learn. For the experienced roentgenologist it is simplicity itself. That the direct measurement by pastilles is also an efficient method, though difficult for some to master, there can be no doubt. This is well illustrated by the statement of Sequeira⁴ that an average of twenty thousand exposures are given yearly in his clinic at the London Hospital "without the risk of dermatitis."

The action of the roentgen ray from the pathologic standpoint has recently been discussed by MacKee, Highman and Rulison,⁵ and Satenstein and Remer.⁶ As MacKee and Highman and Rulison remark, the roentgen ray is equally useful in causing the disappearance of voluminous infiltrations, whether neoplastic or inflammatory, in lessening functional overproduction (as in acne) and in mechanical removal of infected hairs. "Neoplasms," Highman and Rulison write, "including the infectious granulomas, are favorably affected through the influence of the rays on young, rapidly multiplying cells." "The infectious granulomas," they continue, "are partly cured by the same mechanism and possibly because the causative organisms are slightly affected. In inflammatory diseases the hyperplasia of the epidermis is influenced by the inhibitory effects of the rays on the reproducing cells and the infiltration by the destructive effect on the infiltrating cells as well as on the reproducing fibroblasts."

According to Satenstein and Remer, the response of skin diseases to the roentgen ray is due entirely to an inhibition of the function of the cellular elements of the pathologic process. The degree of inhibition desired varies according to the types of the process.

Opinions regarding the value of the roentgen ray in dermatology are still rather varied. While some are most enthusiastic about its use, others feel that it is still too dangerous a remedy to be extensively employed. It is rather significant, however, that the most favorable opinions regarding this agent are held by men whose personal expe-

4. Sequeira, J. H.: *Diseases of the Skin*, Ed. 3, Philadelphia, P. Blakiston's Son & Company, 1919.

5. Highman, W. J., and Rulison, R. H.: Expectancy in Roentgen-Ray Treatment of Skin Lesions from the Pathological Standpoint, *Arch. Dermat. & Syph.* **6**:413 (Oct.) 1922.

6. Satenstein, D. L., and Remer, J.: Roentgen Ray Dosage from the Pathologic Point of View, *Arch. Dermat. & Syph.* **3**:250 (March) 1921.

rience with it has been more or less extensive. In 1917,⁷ I expressed the greatest satisfaction at the results obtained by using a measured dosage in place of the former uncertain methods, an opinion which was reiterated⁸ three years later and which now remains unchanged. Even among those who admit the value of roentgenotherapy in skin disease, some think that it is a last resort to be reserved for deeply infiltrated lesions which are rebellious to all other treatment.

Some of the modern textbooks on dermatology give scant recognition to roentgenotherapy and confine their references to this subject to a few lines or words at the end of the sections devoted to treatment. This is especially true of certain French texts, including the latest work of Brocq⁹ and the volume on treatment of skin diseases by Thibierge and Legrain.¹⁰ Some of the recent English and American textbooks express much more favorable views and devote more space to this subject. To quote a few opinions, Pusey¹¹ says, "It is hardly too much to say that roentgenotherapy is the most widely useful addition to the treatment of skin diseases which has been made." Norman Walker¹² writes, "In the x-rays, dermatology acquired a weapon of remarkable value." Ormsby¹³ says, "During the last few years through improvement in apparatus x-rays have become almost indispensable both as a therapeutic and diagnostic measure." Hazen¹⁴ states that "Roentgen rays are probably the most useful single therapeutic agent that the dermatologist possesses today"; and Highman and Rulison say, "It is undoubtedly the most important single method of managing such diseases" (referring to skin diseases). It is hardly necessary to say that similar views are expressed by MacKee.

Versatile as is the roentgen ray, it should not be regarded as a universal panacea for all skin diseases. While in my opinion, it is our most valuable single therapeutic agent for treating skin diseases, it should not be used to the exclusion of other remedies. There are many

7. Fox, H.: The Coolidge Tube in the Treatment of Nonmalignant Diseases of the Skin, *J. Cutan. Dis.* **35**:599 (Sept.) 1917.

8. Fox, H.: Standardized Roentgen Ray in the Treatment of Skin Diseases, *New York M. J.* **112**:837 (Nov. 27) 1920.

9. Brocq, L.: *Precis-atlas de pratique dermatologique*, Paris, Octave Dou, 1921.

10. Thibierge, G., and Legrain, P.: *Precis de therapeutique des maladies de la peau*, Paris, Gaston Doin, 1922.

11. Pusey, W. A.: *The Principles and Practice of Dermatology*, Ed. 3, New York, D. Appleton & Company, 1917.

12. Walker, N.: *An Introduction to Dermatology*, Ed. 7, Edinburgh, W. Green and Son, 1922.

13. Ormsby, O. S.: *Diseases of the Skin*, Ed. 2, Philadelphia, Lea & Febiger, 1921.

14. Hazen, H. H.: The Roentgen Ray Treatment of Diseases of the Skin, *Am. J. Roentgenol.* **9**:247 (April) 1922.

diseases of unknown etiology which are cured or improved by the roentgen ray. When their causation becomes known, however, we may then be able to treat them in a more rational manner than by local administration of the roentgen ray. Until that time arrives there is no good reason for refusing to use this remedy, provided its safety is admitted.

The action of radium, which will be discussed by the next speaker, Dr. Foerster, is similar in general to that of the roentgen ray. In a few conditions, including among others, certain nevi, leukoplakia and lupus erythematosus, the beta rays of radium are without much doubt superior to roentgen rays. The greater practical value of the roentgen ray is shown by its ability to be used over extensive surfaces of the body and the shorter time required for its administration. Its relatively smaller cost is also a factor to be considered.

Before concluding the general part of my topic, recognition should be given to the pioneers in roentgenotherapy in America as well as abroad. The initiative and courage shown in the early days should not be forgotten at a time when many of the technical difficulties have been overcome. Among American dermatologists in this field should be especially mentioned Pusey, Allen and Piffard, and following them Stelwagon, Hyde, Montgomery, Zeisler, Ormsby, Gilchrist and others.

The therapeutic results obtained in various groups of skin diseases will be considered. Special attention will be paid to inflammatory diseases, as this is a phase of roentgenotherapy about which opinions are more likely to differ. In some of the diseases to be discussed, the roentgen ray (or radium) constitutes our only method of treatment. In others, it is either the best or one of the best remedies we possess. In certain conditions, the roentgen ray is merely an adjuvant to other methods of treatment; in others, it is of doubtful value or even contraindicated. The statistics of my own cases are derived entirely from private practice.

ACNE VULGARIS AND ROSACEA

Acne vulgaris is a disease which has long been successfully treated by the roentgen ray. As to whether this should be used as a routine procedure or reserved for selected cases, there is considerable difference of opinion. Some cases of acne are so mild and so amenable to other therapeutic methods that it would be inadvisable to treat them by roentgenotherapy. When this agent is used, a series of from twelve to fifteen or even twenty treatments of one-fourth skin unit at weekly intervals is generally necessary to clear up the eruption. As a rule no improvement is noted until after the sixth treatment. During the course of roentgenotherapy it is proper to treat individual lesions by surgical methods, though strongly irritating drugs should not be applied.

My experience with acne comprises 191 cases which were followed for a sufficient time to note the effect of treatment. The results in 111 cases were recorded as excellent, the eruption having completely disappeared at the last visit or was so reported by the patient at a subsequent date. In forty-seven cases the eruption was practically well at the conclusion of treatment. Improvement was recorded in twenty-seven patients, many of whom were unable for one reason or another to take the full course of treatment. Three patients showed a severe and one a slight relapse after the eruption had entirely disappeared. The result in two cases was an absolute failure. Persistent and annoying pigmentation, which eventually disappeared, was noted in two cases. In no case was there any evidence of an erythema or when seen later of any injury to the skin. A number of patients presented pitting that is noted so often after spontaneous disappearance of the disease or after treatment by other methods.

A review of the recent literature shows that the majority speak highly of the value of the roentgen ray in acne when it is administered with all proper precautions. Pusey says it is "the method of preference," and MacKee considers it our "most efficacious therapeutic agent," but thinks that it has been and still is abused. Sutton¹⁵ considers it "one of the most valuable remedies we possess." Other similar opinions are expressed by Michael,¹⁶ Reed, Jacoby,¹⁷ Simpson,¹⁸ Leof,¹⁹ Haldin Davis²⁰ and McKenna.²¹ Others including Brocq, Hartzell,²² Ormsby and Schamberg²³ think it should be reserved for rebellious or selected cases. MacLeod²⁴ thinks it of value when comedones are "unusually hard, prominent and numerous."

15. Sutton, R. L.: *Diseases of the Skin*, Ed. 4, St. Louis, C. V. Mosby Company, 1921.

16. Michael, J. C.: *The Use of the Roentgen Ray in the Treatment of Commoner Diseases*, Texas State J. M. **17**:256 (Sept.) 1921.

17. Jacoby, R.: *Roentgen Ray Treatment of Acne Vulgaris*, Boston M. & S. J. **187**:793 (Nov. 30) 1922.

18. Simpson, C. A.: *X-Ray in Dermatology*, Virginia M. Semi-Month. **49**: 122 (June) 1922.

19. Leof, M. V.: *The Value of X-Ray in Skin Diseases*, New York M. J. and Med. Rec. **116**:379 (Oct. 4) 1922.

20. Davis, H.: *Skin Diseases in General Practice*, London, Henry Frowde, 1921.

21. McKenna, R. W.: *Diseases of the Skin and Manual for Students and Practitioners*, London, Bailliere, 1923.

22. Hartzell, M. B.: *Diseases of the Skin*, Ed. 2, Philadelphia, J. B. Lippincott Company, 1919.

23. Schamberg, J. F.: *Diseases of the Skin and the Eruptive Fevers*, Ed. 4, Philadelphia, W. B. Saunders Company, 1911.

24. MacLeod, J. M. H.: *Diseases of the Skin*, New York, Paul B. Hoeber, 1921.

Rosacea is a disease in which the opinions on the value of the roentgen ray are apparently divergent. Its action on the acneform lesions is favorable, although I agree entirely with Hazen and McKenna that it is not as valuable in rosacea as in acne. A diametrically opposite view, however, is held by Schamberg, while Ormsby and Sutton consider it our most valuable local remedy and Pusey and Hartzell speak highly of its use. On the other hand, Highman²⁵ states that "x-rays are harmful" in rosacea. My own experience with twenty-one patients treated by the method used in acne was rather disappointing. Of these eight showed good results (as far as the acne-like lesions were concerned). Improvement was recorded in five and failure in eight cases.

PSORIASIS AND SEBORRHEIC DERMATITIS

In the treatment of such a stubborn and capricious disease as psoriasis, the roentgen ray is at times of great value. It is a cleanly and convenient method and is especially adapted for use on the hands, arms and face, where such a remedy as chrysarobin would not be agreeable. I agree most heartily with the majority of recent writers that the roentgen ray should always be used with great caution in psoriasis and never as a routine method of treatment. The results, as Richards²⁶ says, are erratic "some cases responding in a spectacular manner, while others apparently similar do not respond at all." My own experience comprises 101 cases, of which seventy-five are available for analysis. Of these, only sixteen cleared up entirely or almost entirely, fifty-four showed varying degrees of improvement and fifteen failed to respond to treatment. Some patients were treated with fractional doses, one-fourth skin unit at weekly intervals, others by three-fourths skin units at intervals of three or four weeks. Contrary to an opinion previously expressed, I do not believe there is any material difference between results of larger or smaller dosage. With the accuracy of measurement, which is now possible, a few patients with psoriasis of the scalp were treated with temporary benefit and without any resulting alopecia.

In that ill-defined disease known as seborrheic dermatitis (seborrhea) surprisingly good results were obtained with the roentgen ray. Of forty-seven cases sufficiently followed, the eruption disappeared entirely in thirty-one cases, the patients remaining well for months or years. In twelve instances the eruption had not returned for a period

25. Highman, W. J.: *Dermatology*, New York, The Macmillan Company, 1921.

26. Richards, G. E.: *The Use of X-Rays in Diseases of the Skin*, Canad. M. A. J. **12**:478 (July) 1922.

averaging more than two years. In thirteen cases there was more or less improvement, and in three the result was a failure.

ECZEMA

In the treatment of eczema, or more properly the eczematous group of diseases, my previously recorded enthusiasm over the roentgen ray has not lessened. The value of this agent is not limited, as some suppose, to the intractable, deeply infiltrated patches, but is equally useful in the more acute and superficial types of the disease. In the acute types with marked edema resembling a rhus dermatitis, I would naturally use other remedies until the acuteness had subsided. In the eczematous group of diseases, the roentgen ray is merely a cleanly and convenient local remedy. As in psoriasis, it is specially adapted to the treatment of localized areas and in particular the exposed parts of the body. It may also be used over widespread areas, as Wise²⁷ has



A



B

Fig. 1.—A, eczema, part of an extensive eruption; B, after four treatments of one-fourth skin unit at weekly intervals.

pointed out. While the roentgen ray does not prevent a recurrence of the disease, in a certain number of cases of localized eczema, it apparently effects a permanent cure. The groups of diseases under discussion probably include quite a number which were due to fungus infection, though the diagnosis of such conditions is notoriously difficult. Some of the cases would have been classified by my colleagues as neurodermatitis, while some others may have been due to various unrecognized external irritants.

The opinions of other writers regarding the value of roentgenotherapy in eczema are in a general way favorable. Eichenlaub,²⁸ in reporting 100 unselected cases of the "eczema group," states that

27. Wise, F.: Roentgen Ray Treatment of Widespread and Generalized Diseases of the Skin, *J. A. M. A.* **73**:1491 (Nov. 15) 1919.

28. Eichenlaub, F. J.: The Roentgen Ray Treatment of the Eczema Group, *Am. J. Roentgenol.* **8**:520 (Sept.) 1921.

"the cause whether internal or external played little part in the result of treatment." He concludes that "the superiority of x-ray over other forms of treatment is believed to be demonstrated in this group and its routine use justified," an opinion that coincides precisely with my own. MacKee says, "visualizing the disease in a general way it is the author's opinion that x-ray (or radium) is the best remedy we have for eczema." Semon,²⁹ from an experience in 100 cases, considers the roentgen ray more or less amenable in chronic and subacute types, especially when localized. Special stress is laid on its value in eczema of the hands and feet by Sutton, Pusey, Ormsby, Schamberg, Hartzell and Haldin Davis. MacLeod favors the roentgen ray for markedly lichenified and itchy patches, while various favorable opinions are expressed by Guy Lane,³⁰ Richards, Baer,³¹ Reed and Simpson.

My material comprises 405 cases, 102 of which were clinically cured, that is, they were entirely free from their eruption when

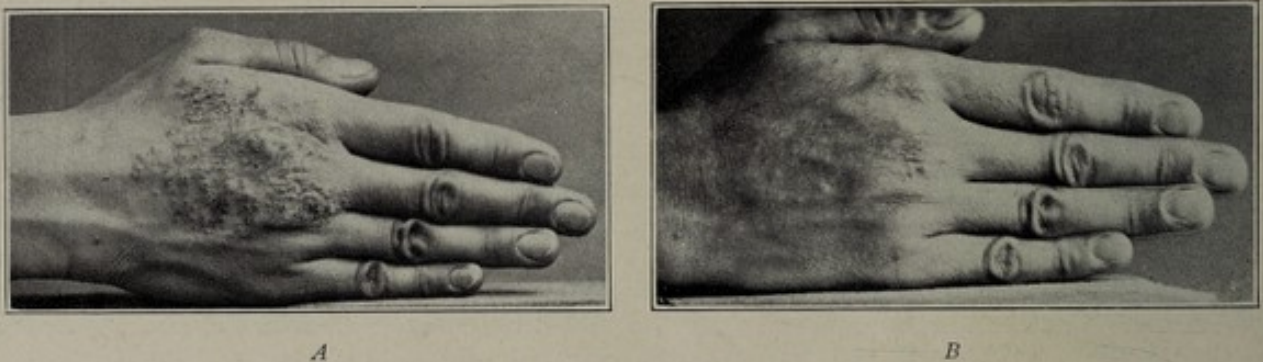


Fig. 2.—*A*, eczema, of hand; *B*, after four treatments with one-fourth skin unit at weekly intervals.

last seen. Of these thirty-four have been followed for periods ranging from one to seven years, during which time they have remained well. Fifty-seven patients were practically well at the last visit; seventy showed great improvement and 100 were recorded as improved. There were failures or unsatisfactory results in twenty-eight cases. In five cases the eruption disappeared, recurred and again disappeared. In twenty-five cases there was a slight and in two cases a severe relapse after the complete disappearance of the eruption, while sixteen showed only temporary improvement. The average duration of the disease was

29. Semon, H. C.: X-Rays in Dermatology, *Practitioner* **108**:259 (April) 1922.

30. Lane, C. Guy: The X-Ray in Dermatology, *Am. J. Roentgenol.* **8**:476 (Aug.) 1921.

31. Baer, C. A.: X-Rays in Dermatology, *Wisconsin M. J.* **19**:177 (Sept.) 1920.

twenty months, and the average number of treatments 5.3. The dosage was one-half skin unit at the first visit, followed by weekly treatments of one-fourth skin unit.

LICHEN PLANUS AND LICHENIFICATION

My opinion (formerly expressed) regarding the treatment of lichen planus with roentgen ray still remains decidedly favorable. With the exception of the roentgen ray (or radium), I am not familiar with any local agent that has any appreciable effect on the lesions of the ordinary type of lichen planus. Other local remedies do no more than relieve itching. In my opinion the roentgen ray is not merely suited for the chronic hypertrophic type, but for the ordinary type as it appears on the forearms or large areas of the body. It not only relieves the itching, but materially shortens the course of the disease. The majority of authors seem to share the opinion of Darier³² that it is only suited to "localized eruptions," while Semon considers that "the more widespread irritable eruptions of this disease in its acute form should never be submitted to radiotherapy which will certainly aggravate them."

My own experience is limited to nineteen cases of the ordinary type, ten of which were entirely cleared up by the roentgen ray. In four of these, the disease was generalized. In one particularly profuse eruption of two and a half months' duration, the lesions entirely disappeared at the end of seven weeks. Seven patients improved, two of whom had localized recurring attacks of the wrists and palms. In one of these patients a slight telangiectasia resulted. In two cases the result was a failure except for the relief of itching. The dosage used for this type of the disease was similar to that used for eczema.

Of seven cases of lichen planus hypertrophicus, four were cured or practically so, one showed improvement and in two cases the result was a failure, one of the latter patients having received large doses of both unfiltered and filtered irradiation.

The results of treatment in lichenification (lichen simplex chronicus, neurodermatitis) were also gratifying, a few cases being permanently relieved by a single large dose of three-fourths to one skin unit. Other cases responded well to fractional doses as used in eczema. Of seven cases in which the result of treatment was ascertained, five patients were cured, one was greatly improved, and one failed to respond to treatment. In one case of the so-called Fox-Fordyce disease, the lesions in the axillae failed to disappear after six treatments of one-fourth skin unit, although there was decided relief from itching.

32. Darier, J.: A Text Book of Dermatology, Pollitzer, Ed., Philadelphia, Lea & Febiger, 1920.

OTHER INFLAMMATORY DISEASES

In a number of other inflammatory diseases the roentgen ray has proved to be of more or less value. In most of the following, my experience has been limited. In all of them the dosage has been the same as in eczema. Of seven cases of Duhring's disease which were observed long enough to judge of the results of treatment, the eruption entirely cleared up in one instance. In five cases there was improvement and in one case no improvement except relief of itching. In one case of prurigo nodularis, no benefit was noted. The results in two cases of cheilitis exfoliativa were most gratifying, a clinical cure having been obtained after five and nine weekly exposures, respectively, of one-fourth skin unit. In four cases of pompholyx there was a successful and quick response to irradiation. Of three cases of acne varioliformis, two were improved and one failed to respond to treatment. A single case of pityriasis rosea was treated in which the eruption was noticeably profuse on the neck. The lesions in this region almost completely disappeared at the end of a week after irradiation with one-fourth skin unit.

RINGWORM AND FAVUS

The treatment of ringworm and favus of the scalp constitutes one of the most brilliant achievements of roentgen therapy. As the results are so well known and generally accepted, the subject will be rather briefly discussed. To Sabouraud belongs the greatest credit for introducing a method of epilating the scalp by the aid of the Sabouraud-Noiré radiometer. His procedure, while successful, has been generally replaced by the much simpler Kienböck-Adamson method in which five different areas of the scalp are irradiated at one sitting. As the details of this method have been fully described among others by MacKee, Hazen³³ and by Anderson³⁴ and myself, they need not be further considered at this time. The work which Dr. Anderson and I began at Ellis Island has been continued, and at the present time more than 300 persons with ringworm and favus of the scalp have been treated there. In Dr. Fordyce's service at the Vanderbilt clinic more than a thousand patients have been treated without a single resulting permanent alopecia. Dr. James H. Sequeira of London informed me two years ago that over 6,000 patients with ringworm of the scalp had been treated in his clinic at the London Hospital. In his analysis of the last consecutive thousand cases, there were only four in which there had been a deficient growth of hair. The safety of the method, when

33. Hazen, H. H.: The Roentgen Ray Treatment of Tinea Tonsurans, *J. Cutan. Dis.* **37**:307 (May) 1919.

34. Fox, H., and Anderson, T. B. H.: Treatment of Ringworm of the Scalp by the Roentgen Rays, *J. A. M. A.* **77**:1302 (Oct. 22) 1921.

properly carried out, is generally admitted, even the possibility of brain injury, as pointed out by MacLeod,³⁵ being without foundation.

A great satisfaction afforded by the roentgen-ray treatment of ringworm is its practical proof of our ability to measure dosage. To obtain a proper epilation, a definite amount of irradiation must be given. If this amount is exceeded there may be permanent alopecia, while if the dosage is too small, epilation will not be produced and the disease will remain uncured. Of four patients with ringworm of the bearded region, three were cured after three, five and six treatments, respectively, of one-fourth skin unit given at weekly intervals.

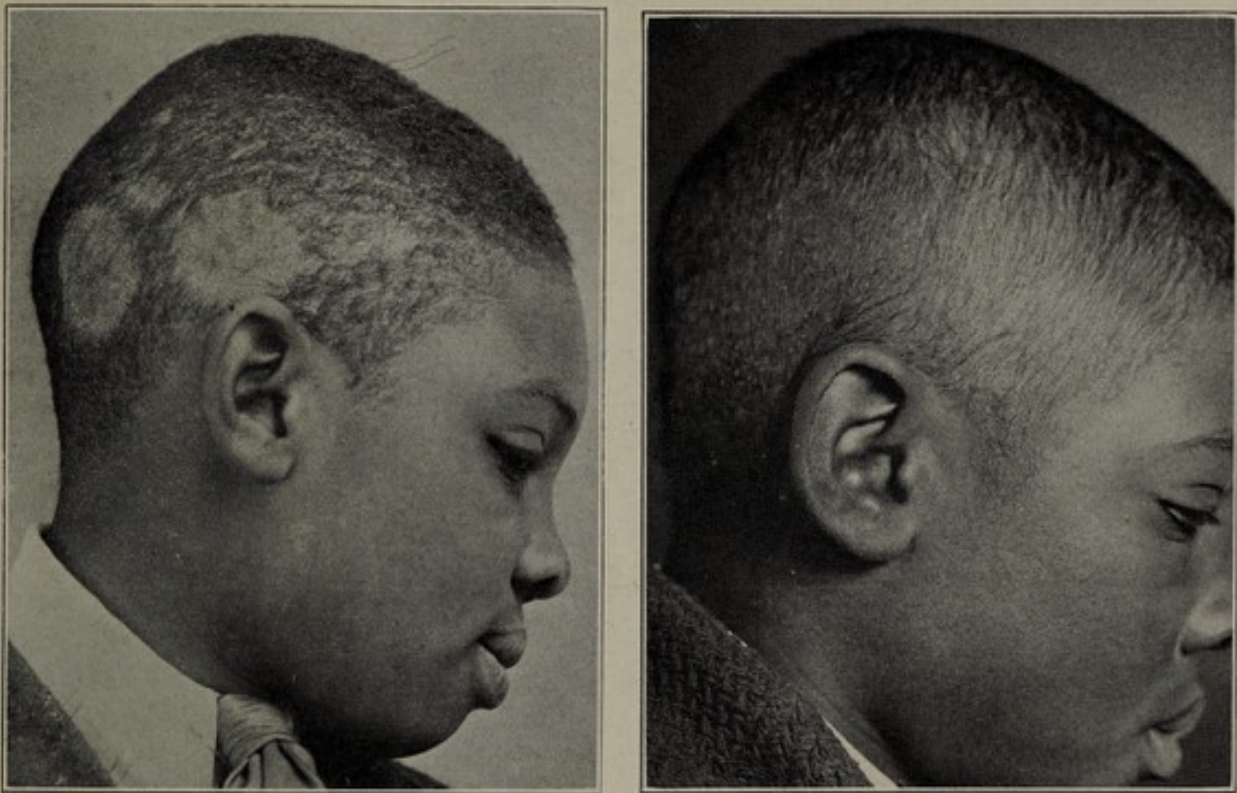


Fig. 3.—*A*, tinea capitis; *B*, after epilation. The new hair is temporarily straight.

As to why the roentgen ray should have a curative effect in ringworm or favus of the nails, does not appear to be clear. Of thirty cases, microscopically proved, MacKee was able to obtain eighteen cures, an astonishing result. Hazen writes that in this condition he has had a "few good results and many failures." My own experience is limited to three cases, in only one of which a cure was obtained, the patient remaining well for seven years.

35. MacLeod, J. M. A.: The X-Ray Treatment of Ringworm of the Scalp with Special Reference to the Risks of Dermatitis and the Suggested Injury to the Brain, *Lancet* 1:1373 (May 15) 1909.

STAPHYLOCOCCIC INFECTIONS

As my experience with sycosis increases, so does my respect for the difficulty of curing it. I agree with MacKee who states that in the use of the roentgen ray the "results range from brilliant to poor." He thinks that the majority require epilation and adds that "occasional cases demand permanent alopecia, and at times even a permanent alopecia will not effect a cure." Some of the results of treatment are certainly brilliant, particularly when the disease is not extremely chronic. In some severe cases I have failed to effect a cure even with repeated epilations. Such a case with which Wende had had a similar experience recently came to my attention. In my own series of twenty cases, clinical cures resulted in eleven cases and failures in nine cases. One of the most surprising results was shown by an elderly man who had suffered from sycosis of the lip and bearded region for fifty years. After treatment extending over a period of four months, with partial temporary alopecia, he was entirely cured and had remained so at the last report six years later. Of six cases of staphylococcic folliculitis of the nape of the neck and pubic region, three were clinically cured and three improved. In one severe case of sycosis with accompanying folliculitis of the scalp, temporary epilation of the scalp did not effect a permanent cure.

With the use of roentgen ray in furunculosis I have had no experience. That such treatment is of some value in localized recurring boils, I do not doubt, favorable opinions in this regard being expressed by Pusey, Ormsby and MacKee.

INFECTIOUS GRANULOMAS

The infectious granulomas constitute another group of diseases in many of which the roentgen ray is curative or beneficial, syphilis being a notable exception. That actinomycosis and blastomycosis are favorably affected by the roentgen ray, is shown by a number of reliable statements. Many of the reported cures, however, were obtained by a combination of roentgenotherapy and administration of potassium iodid. I have had no personal experience with these diseases, but have had the opportunity of treating one patient who had sporotrichosis, in whose case the diagnosis had been confirmed by culture. At the time of his first visit to me, the patient presented five active lesions. Four of these healed completely under roentgenotherapy alone, all except one requiring only a single skin unit to effect this result. Rhinoscleroma is another rare disease of this class in which roentgenotherapy has proved curative, a case of this kind having been successfully treated by Pollitzer³⁶ with no recurrence at the end of three years. I have

36. Pollitzer, S.: Rhinoscleroma Cured by X-Ray Treatment, J. Cutan. Dis. 28:388 (Aug.) 1910.

treated one patient with granuloma inguinale by the roentgen ray, with good results. The ulceration had almost entirely healed when the patient discontinued treatment. A histologic examination strongly corroborated the clinical diagnosis, although no organisms were found. The patient was treated on five occasions with a total dosage of three and one-half skin units. In a case of this disease treated by MacLeod, the roentgen ray was found to be a useful aid.

As I have not used the roentgen ray in the treatment of lupus vulgaris, except in a single case, my opinion on the subject is based on the reports of others and results of treatment of cases shown at our numerous dermatologic meetings. Pusey considers that the roentgen



Fig. 4.—*A*, sycosis (staphylococcus); *B*, after treatment. The patient when seen ten years later had had no recurrence of the disease, and there was no injury to the skin.

ray "gives the same excellent results as Finsen therapy," although he considers the Finsen lamp preferable for small patches of lupus. MacKee considers roentgenotherapy "in point of efficiency second to phototherapy." The majority of writers on this subject seem to think that the roentgen ray is chiefly suited to the ulcerative or hypertrophic types or both, including Darier, Sequeira, MacLeod, Haldin Davis, McKenna, Schamberg and Hartzell. Hazen and Norman Walker warn against the possibility of epithelioma if the treatment is pushed too vigorously. The single case that I treated with eight doses of 1 skin unit each showed marked improvement, probably because it was of the hypertrophic type. In tuberculosis verrucosa cutis, the roentgen ray

is undoubtedly of value, and also in scrofuloderma, a few cases of which I have successfully treated by filtered irradiation.

In this connection a few words should be said in regard to the so-called tuberculids, including lupus erythematosus, which may or may not rightly be included in this category. The treatment of Bazin's disease has been favorable; in one case of my own the eruption cleared up after a single treatment, one lesion receiving 1 and another $1\frac{1}{2}$ filtered units. Sarcoid also responds at times, one case of mine of the Darier-Roussy type (proved histologically) showing marked improvement under filtered irradiation. I have not treated any cases of papulonecrotic tuberculid, although Ormsby, Knowles, Ketron and

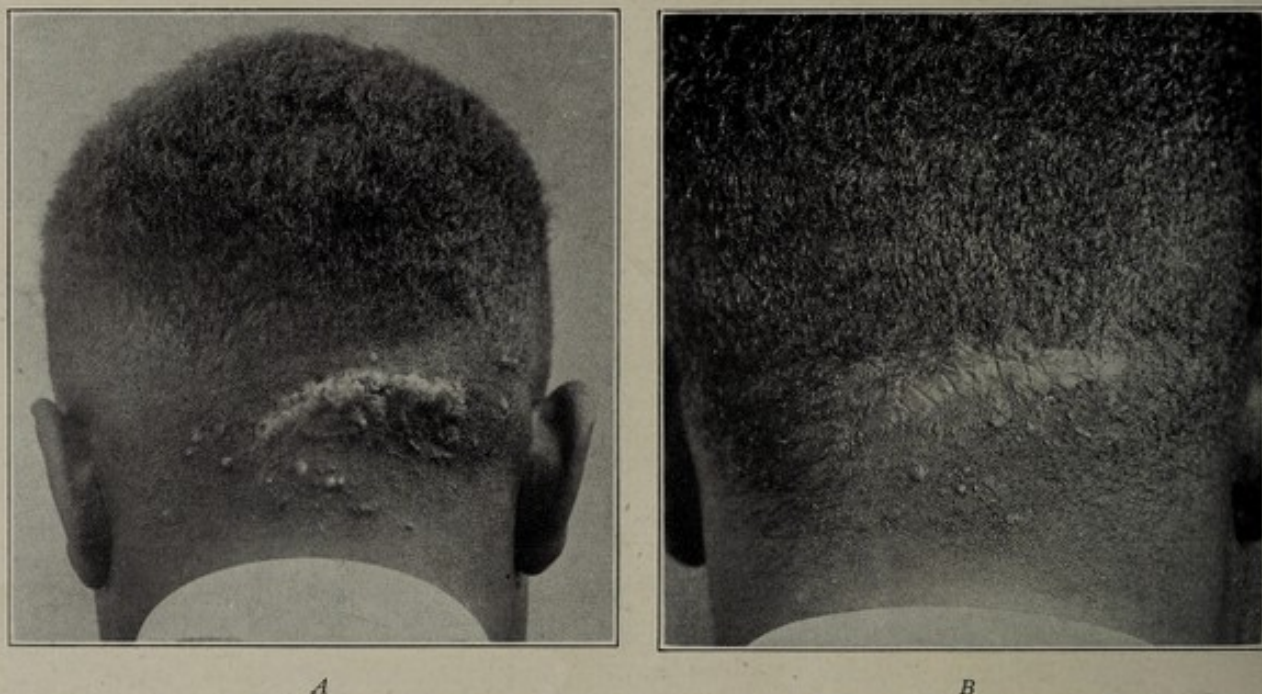


Fig. 5.—*A*, dermatitis papillaris capillitii; *B*, after eleven treatments of 1 filtered unit each at intervals of two weeks.

Bronson (quoted by MacKee) recorded good results in eruptions of this type. Except in three instances, I have purposely avoided any attempt to treat lupus erythematosus with roentgen ray, as the opinions of others in regard to this method of treatment were so adverse. There was nothing but failure to record in my few cases, although one patient was treated and followed for a considerable length of time.

NONINFECTIOUS GRANULOMAS

In the treatment of the so-called noninfectious granulomas, especially mycosis fungoides, the roentgen ray has scored another triumph. Even those who are most pessimistic about roentgenotherapy will admit

its value in these conditions in which no other remedy (except radium) has been able to produce any consistent results. MacKee was unable to find any reference to a permanent cure by the roentgen ray, although two cures by arsenic are on record. In spite of this, the roentgen ray (or radium) is our main reliance in the treatment of mycosis fungoides. While many cases in both early and late stages respond to radiotherapy, the time eventually arrives when this method of treatment loses its efficacy, and the patient succumbs to the disease. A few cases respond unfavorably or not at all to radiotherapy. My personal experience is limited to the treatment of three cases, in one of which an extensive eruption had previously been held in check for several years by a



A



B

Fig. 6.—A, lymphosarcoma; B, four days after a single treatment of 2 filtered units. Other tumors appeared later, with fatal termination.

colleague. In spite of my efforts, the disease could no longer be controlled. In another case (a patient of my father, Dr. George Henry Fox), a few localized patches promptly disappeared after one treatment with one-half skin unit. A third patient with a generalized pre-fungoid eruption (diagnosis also histologically made) showed only slight improvement after six treatments, with a dosage of from one-half to three-fourths skin units.

In a case of Hodgkin's disease with lymphogranulomatous tumors of the skin³⁷ I was able to cause a complete involution of the tumors

37. Fox, Howard: Lymphogranulomatosis of the Skin in Hodgkin's Disease, *Arch. Dermat. & Syph.* 2:578 (Nov.) 1920.

situated on the scalp, by filtered irradiation. Wise's case of universal lymphogranulomatosis cutis was also benefited by roentgenotherapy. While little work has been done with true leukemic infiltrations in the skin, such a condition should by analogy prove amenable to the roentgen ray.

VERRUCOUS AFFECTIONS

In the treatment of diseases characterized by verrucous lesions or eruptions, the roentgen ray (or radium) has proved of more or less value. In a few, it is the equal of any other remedy, if not the method of choice. Good results can often be obtained in verruca vulgaris, particularly when the lesions are few enough to be closely screened and irradiated singly. Failures are often noted, however. I have treated thirty-three patients, in eighteen of whom the result of irradiation is known. In twelve of them a cure was obtained with an average of less than two treatments and an average total dosage of $2\frac{3}{4}$ skin units. In six cases, failures were recorded. The most favorable effect in this class of affections is seen in the so-called plantar wart. Hazen and Eichenlaub³⁸ report the cure of fifteen out of sixteen cases of this condition, and in a later paper by Hazen the total is increased to twenty-four, all except one having been cured. MacKee obtained a cure in twenty out of thirty cases. In my experience a cure was noted in six out of nine cases, an average of two treatments being given with a total dosage of $2\frac{3}{4}$ skin units. Some of the advantages of this treatment are its simplicity and painlessness, and of great importance, the entire absence of scarring.

Good results were shown in my limited experience with callosities and clavus. Three cases of callosities were cured by the roentgen ray, one patient receiving one treatment of $1\frac{1}{2}$ skin unit, a second two treatments of 2 skin units, a third three doses of $1\frac{1}{4}$ skin units each. Three cases of clavus were also apparently cured by somewhat similar dosage, one patient being free from his trouble when seen two years later. Three cases of condyloma acuminatum were treated with no result. One patient with large growths about the vulva received five treatments, each of 1 skin unit. Filtered irradiation was not tried.

There is no doubt about the favorable effect of the roentgen ray on the senile and seborrheic keratoses, although in these conditions I have preferred other remedies, either alone or in combination with irradiation. In the treatment of hereditary keratoderma of the palms and soles hardly more than a temporary improvement could be expected. In two cases of my own, however, no improvement resulted, one patient being given three doses with a total of $2\frac{3}{4}$ skin units and the other four

38. Hazen, H. H., and Eichenlaub, F. J.: The Roentgen Ray Treatment of Verruca Plantaris, J. A. M. A. **74**:1311 (May 8) 1920.

treatments of 1 skin unit each. I have had one case of Darier's disease in which the roentgen ray was used rather extensively. Most of the treatment was given before measured dosage was adopted, and considerable telangiectasia has resulted. I previously expressed myself as being disappointed in this result, though doubtless no other agent (except radium) would have had much effect on the eruption. This particular patient suffered a number of times from rather severe constitutional effects following treatment. On several occasions after doses of 1 skin unit had been administered to three or four areas she was ill for one or two weeks. In the treatment of four cases of Darier's disease reported by Mook,³⁹ good results were obtained.

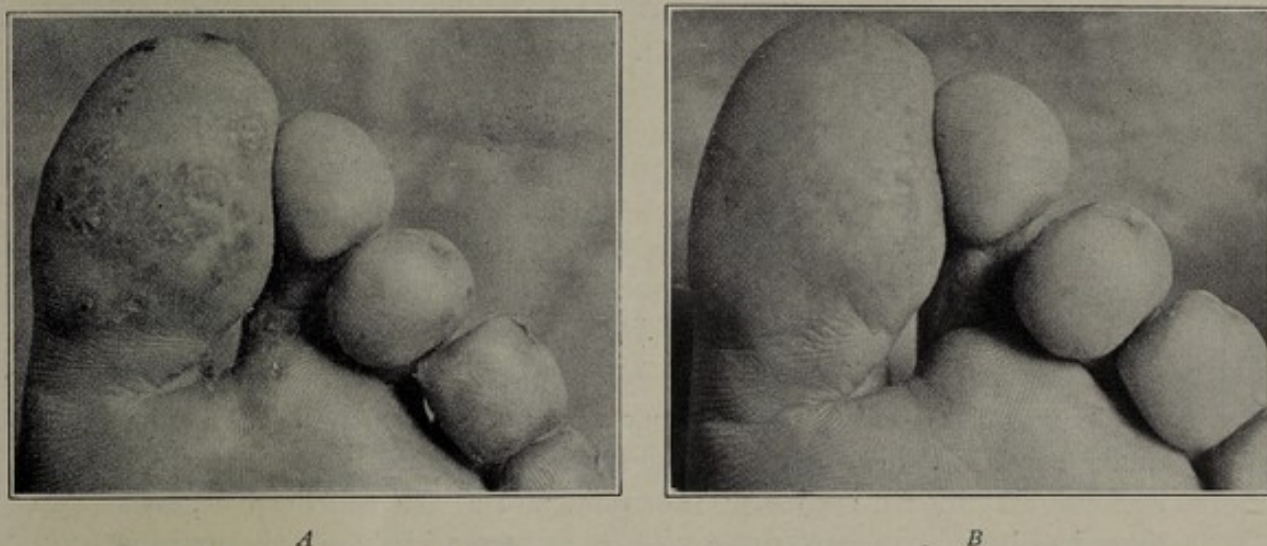


Fig. 7.—*A*, verruca plantaris; *B*, after a single treatment of one and one half skin unit.

PRURITUS

The antipruritic effect of the roentgen ray in itching diseases, such as eczema, lichen planus, mycosis fungoides, etc., is of course well known and constitutes one of its most valuable attributes. In addition, it is of unquestioned value in localized itching, particularly of the anus and vulva. It is hardly necessary to say that before trying irradiation every attempt should be made to ascertain and, if possible, to remove any causative factor. While not as a rule curative, the roentgen ray nevertheless gives the greatest relief at times. In generalized pruritus without visible lesions, its effects are much less favorable. Of eight cases of pruritus vulvae, good results were obtained in six and improvement in two cases, while two others were failures. The dosage varied

39. Mook, W. H.: Report of Four Cases of Keratosis Follicularis (Darier's Disease), *J. Cutan. Dis.* **30**:722 (Dec.) 1912.

from three-fourths to 1 skin unit. In six cases of pruritus ani, good results were obtained in two and more or less marked improvement in four cases. In four cases of generalized pruritus without visible lesions, improvement was noted in one and failures in three cases. In three cases of pruritus limited to the extremities good results were obtained.

HYPERHIDROSIS

Localized hyperhidrosis of the palms, soles and axillae is a functional disease which can be permanently cured by the roentgen ray, a statement which I do not think can be made of any other agent (except radium). Great care must always be observed in watching the patient's progress, and irradiation should not be pushed to the point of complete cessation of sweating. Abnormal dryness of the palms which follows excessive treatment cannot be cured. MacKee's advice is to stop irradiation when there is from 50 to 75 per cent. of improvement. Favorable opinions regarding the treatment of this disease are expressed by Pusey, Sutton, MacKee, Highman and others. Schamberg states that he has seen "patients with water dripping from their hands, secure happy results from the use of x-rays." Of fourteen patients treated by me, the records of eight are complete enough to quote. In three cases, perfect results were obtained, in two improvement was noted, while three were failures. One of the successful results was obtained in a 'cello player who suffered from such sweating of the palms that his occupation had to be discontinued. He was cured by eight treatments, each of 1 skin unit, and at the end of five years there had been no return of the disease, nor were his hands abnormally dry. The other patients were cured by a smaller number of treatments, in one case by a dose of three-fourths skin unit (hyperhidrosis of the soles). I am inclined to think that larger doses at proper intervals are more effective than the small doses, such as one-fourth skin unit. At all events, two of the failures were noted in patients who were treated for a considerable time by smaller doses.

KELOID

There seems to be an almost general agreement that the most effective treatment of keloid is by radiotherapy alone or in combination with surgery. It seems reasonably clear that the cases which show the best response are the comparatively early ones. It is also generally agreed that in the treatment of keloid an erythema should be avoided. The majority of patient's should be treated by filtered irradiation. Of the few patients with keloid whom I have treated, only one remained under observation for a reasonable length of time. She presented a small lesion of the chest which had been present for eight months. No

improvement was noted after eight filtered units had been given. Dermatitis papillaris capillitii responds well to roentgenotherapy, MacKee stating that it will cure every case. In one of my patients who remained under treatment for a sufficient time, the keloidal mass was entirely flattened after ten filtered units had been administered, improvement being noticed after the fourth treatment.

MALIGNANT NEOPLASMS

While the roentgen ray has been and still is of enormous value in the treatment of malignant neoplasms, the last word on this subject has by no means been said. In the case of epithelioma, the literature is extremely voluminous, though in the majority of reports the important distinction between basal cell and prickle cell epithelioma is not made. In the treatment of the prickle cell epithelioma, the roentgen ray is generally used in combination with other methods, including surgery, electrocoagulation and radium. While often treated by the dermatologist, this form of cancer is essentially a surgical disease and owing to lack of time will not be discussed in this paper. That basal cell epithelioma can be cured by the roentgen ray alone has been well known for many years. I feel convinced, however, that if the lesion is thoroughly curetted previous to irradiation, a higher percentage of cures will be obtained. Belot⁴⁰ speaks of this as the "methode mixte" and states that he has used it with success for the past twenty years in the treatment of over a thousand cases. He obtained from 90 to 95 per cent. of successes and thinks that no other method can give comparable results. When the disease involves the cartilage of the nose or ear the difficulty of effecting a cure is greatly increased.

MacKee in some large and carefully compiled statistics says that of 282 unselected cases observed for periods of six months to nine years or more, 13 per cent. of relapses were noted, leaving a total of possible permanent cures of 87 per cent. From an experience with 147 epitheliomas Hazen⁴¹ states that "the results in this series are practically identical with those from good surgery."

In my use of the roentgen ray in basal cell epithelioma irradiation has invariably been preceded by a thorough curettage. My material comprises ninety-four cases treated in this manner. In only a few instances was the diagnosis confirmed by histologic examination. Cases of epithelioma of the ear are not included, as in this location the use of radium has been preferred. Epitheliomas of the extremities and of the lip

40. Belot, M. J.: Le traitement radio-chirurgical de l'epithelioma cutane, *Medicine* 1:540 (June) 1920.

41. Hazen, H. H.: Roentgen Ray Treatment of Cutaneous Cancer, *J. A. M. A.* 76:1222 (April 30) 1921.

have also been omitted, as practically all of the former and most of the latter are of the prickle cell type. Four of my cases were more or less hopeless at the outset, and a cure was not expected.

Omitting these cases, there were ninety examples of the ordinary basal cell epithelioma of the face, mostly of small size and with little or no previous treatment. In other words, such a material was ideal for obtaining a large percentage of perfect results. Of the ninety patients, thirty-one did not remain under observation more than a few weeks after treatment. Of the fifty-nine selected cases of basal cell epithelioma of the face, a clinical cure was noted in 95 per cent. at the end of an average period of two and one half years. A recurrence was noted in three patients (5 per cent.), to all of whom a smaller amount of irradiation had been given. In all except two cases, the preliminary curettage was performed immediately before treatment. In the two exceptions irradiation was given a few days after curetting. In fifty-one cases, 2 skin units (in one treatment) were administered, in three cases $2\frac{1}{2}$ skin units, while in five others, smaller doses (earlier cases) were given. While the time that has elapsed since treatment is not very long, I have been convinced from the small number of recurrences that much better results have been obtained by this method than by the use of curettage and cauterization (acid nitrate of mercury, etc.). The resulting scars have been inconspicuous as a rule, comparing favorably with those following the use of radium.

The value of roentgenotherapy in sarcoma is chiefly limited to fibrosarcoma or lymphosarcoma and to the disease which bears the name of Kaposi. In one case of the lymphosarcoma type, an apparently brilliant result was obtained which proved to be only temporary. In the disease known as Kaposi's sarcoma, which more properly comes under the care of the dermatologist, favorable results are obtained by roentgenotherapy. In the early stages, it is claimed that such treatment is curative, while in the later stages the disease can long be kept under control. In two cases of my own, the tumors disappeared under both filtered and unfiltered irradiation.

HYPERTRICHOSIS

The first therapeutic result obtained by the roentgen ray was the epilation of a hairy nevus by Freund. As a natural consequence, attempts were soon made to treat hypertrichosis by this new agent. In spite of persistent efforts during the succeeding years to establish a safe technic for this disease, the goal has not yet been attained. I agree with the majority of writers that with our present knowledge, roentgenotherapy is not suitable for treating hypertrichosis, except perhaps in a few selected cases.

MISCELLANEOUS DISEASES

Lichen nitidus is a disease in which, according to Trimble and Maloney, "treatment has very little if any effect in most cases." In a patient under my care (included in Trimble and Maloney's⁴² recent report on the subject) favorable results were obtained by the roentgen ray. One area was treated experimentally with fractional doses (one fourth skin unit) and entirely disappeared. As a result, the remaining groups of papules were irradiated, and the entire eruption had nearly disappeared when the patient discontinued treatment.

Lingua geographica is another disease which to my knowledge has not been previously treated by the roentgen ray, although Ormsby states that in this condition "radium has been successfully employed"

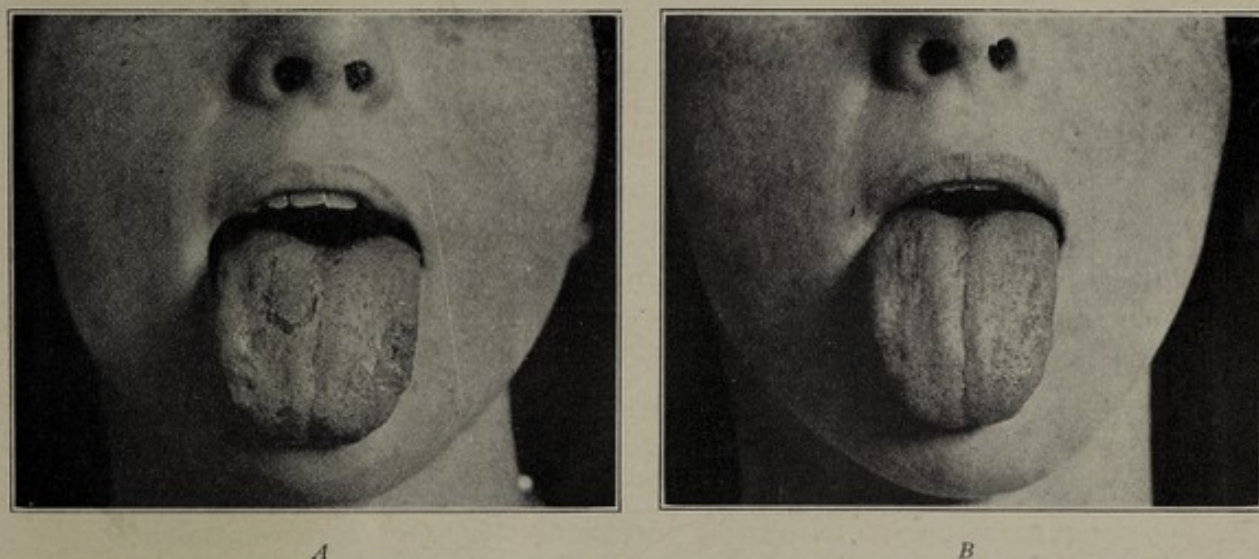


Fig. 8.—*A*, lingua geographica; *B*, after two treatments of one-fourth skin unit. The patient had been entirely free from the disease for seven months.

by him "in several instances." One of my patients was a girl, aged 22, who had suffered almost continuously from the disease for ten years. Previous to treatment she had never had more than a week of freedom from the disease, which in her case was the occasion of considerable discomfort after eating. Two treatments with one-half skin unit each gave her complete relief, and up to the time of writing (seven months after treatment) she had been entirely free from her affliction. In another case, a man, aged 38, who had suffered from the same condition for twelve years, the result, while most satisfactory, was not as brilliant. To give him relief it was necessary to irradiate the tongue on five occasions. The time is of course too short to judge of the

42. Trimble, W. B., and Maloney, E. R.: Lichen nitidus, Arch. Dermat. & Syph. 7:452 (April) 1923.

permanency of the results in these cases, although they seem at least encouraging.

One patient with syringocystoma was successfully treated with roentgen ray, one side of the trunk being treated for comparison. This area cleared up entirely after eleven exposures of one-half skin unit.

In one case of urticaria pigmentosa in an adult, the result of roentgenotherapy was striking, although the time is still too short to judge of the permanency of results. One side of the trunk was treated, and after ten exposures of one-half skin unit, the eruption had practically disappeared, and there had been no recurrence at the end of four months.

In five cases of paronychia in which the roentgen ray was given a fair trial, improvement was noted in one case and complete failure in the others. Unsatisfactory results after considerable irradiation were also obtained in a case of so-called pemphigus of the conjunctiva and in one of neurotic excoriations. In one case of synovial lesions of the skin there was no improvement from a single dose of $2\frac{1}{4}$ skin units.

Two cases of recurrent herpes simplex have been treated by roentgen ray, but the time is too short to determine the results. In one case of severe and persistent pain following a thoracic zoster, two treatments each of 1 filtered unit were given over the corresponding ganglions. No relief from pain was obtained.

To complete the list of skin diseases in which the roentgen ray has been claimed to be of greater or less value, the following should be mentioned: acanthosis nigricans; Addison's disease; adenoma sebaceum; dermatitis exfoliativa; dermatitis vegetans; erythromelalgia; folliculitis decalvans; granuloma pyogenicum; ichthyosis; kraurosis vulvae; leukoplakia; lichen scrofulosorum; lymphangioma; lymphangitis (chronic streptococcic); nevus (vascular and hairy); Paget's disease of the nipple; parapsoriasis (lichenoid type) and xeroderma pigmentosum.

CONCLUSIONS

1. With modern apparatus the roentgen ray can be accurately measured, either directly by pastilles or indirectly by electrical methods.
2. The indirect method is preferable as it is simpler, more accurate and eliminates the personal equation.
3. With proper precautions the roentgen ray can now be safely employed in a routine manner.
4. The versatility of the roentgen ray is shown by its favorable action on such varying conditions as inflammatory and functional diseases, granulomas and neoplasms.

5. The roentgen ray is the best local remedy for the routine treatment of acne vulgaris, eczema, seborrheic dermatitis and lichen planus. In rosacea it is unsatisfactory except for its favorable effect on the acne-like lesions. In psoriasis it should be used with great caution and only in selected cases.

6. The brilliant action of the roentgen ray in ringworm and favus of the scalp constitutes one of its greatest achievements. Good results can also be obtained in sycosis and folliculitis.

7. Alone or in combination with other methods of treatment the roentgen ray has proved of great value in some of the infectious granulomas.

8. In its ability to check the progress of mycosis fungoides, together with radium, it holds a unique position.

9. In certain diseases characterized by verrucous lesions or eruptions, the roentgen ray is of greater or less value. In plantar warts it is the method of choice.

10. As a palliative in anal and vulvar pruritus and as a curative agent in localized hyperhidrosis, the roentgen ray is invaluable.

11. Alone or in conjunction with surgery it is the best agent for the treatment of keloid.

12. In malignant diseases the roentgen ray has been of the greatest value in the treatment of basal cell epithelioma, the best results being obtained when used in connection with curettage.

13. In lupus erythematosus it is of little or no value, and in hypertrichosis its use is in general contraindicated.

14. Among other less common diseases in which the roentgen ray appears to be of decided value should be mentioned lichen nitidus and lingua geographica.

15. The roentgen ray is the most valuable agent we possess for the treatment of skin diseases.

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