

Part V
CLINICAL—MISCELLANEOUS
INFECTIONS

Chapter XIX

SUPERFICIAL AND OTHER INFECTIONS

Among the first conditions successfully treated with x-rays were localized pustular lesions, adenopathies and the more or less diffuse superficial infections of the skin and subcutaneous structures. Since it is relatively easy to observe the effects of x-rays on the skin, one's first experience in radiation therapy is often in treating some of these superficial, often self-limited, infections. The novice uses this type of lesion as a stepping stone to the treatment of more complicated conditions, and the more experienced radiation therapist uses this type to learn more about the specific effects of the rays on various organisms with various technics. The novice using even a small dose does some good, gains some courage and eventually builds up the dose and his courage to a point where he can treat safely more serious, or at least more stubborn, infectious diseases.

Early in our experience, it was evident that the more rapidly growing organisms could best be treated at frequent intervals with small doses, other less active organisms with an increased space of time between treatments and slightly larger doses, and the more indolent, slowly growing organisms with a still greater space factor and larger doses. Thus, if one wishes to use a safe and sure procedure it is necessary to treat erysipelas and other rapidly spreading infections twice each day; infections with the staphylococcus, a more slowly growing organism, once each day; and infections with the fungi and other organisms which grow slowly and give rise to the granulomatous type of lesion, once every three to six days. Obviously, the earlier any of these infections is treated the more promptly will it be controlled.

ERYSIPELAS

Erysipelas is an acute, usually rapidly spreading infection of the lymphatics of the skin, caused by the entrance and growth of the streptococcus. The point of entrance may be an imperceptible break in the skin, a surgical incision or some other gross break in the skin.

The organism is a strain of streptococcus which can be differentiated by immunologic methods from the scarlatinal strains and from a large series of miscellaneous hemolytic streptococci.¹

The commonest site is the face, particularly on the nose and around the eyes, from which it spreads backward and may envelop the entire head and neck unless treatment is started early. Some people are known to have had several attacks of erysipelas at intervals of a year or more. The disease may follow operation for suppurative mastoiditis, or many other conditions may be a factor in its inception. Often the predisposing factor is undetermined.

Usually there are early and severe toxic manifestations. There is frequently a chill followed by a rise in temperature, rapid pulse rate and some increase in respiratory rate. With facial erysipelas, delirium may be present.

The toxemia and rapidity of extension of the process are the outstanding clinical features. Rarely do any marks of the disease remain after convalescence, a fact which indicates not a locally destructive organism but a toxin-producer, the type of organism which seems particularly amenable to small, often repeated doses of x-ray. Occasionally there may be some subcutaneous invasion with pustular formation and less often bacteremia, which is usually fatal.

In Boyd's consideration of the morbid anatomy, he noted that: "The inflammatory cells are mainly lymphocytic and wandering mononuclear cells."² He also emphasized the fact that whereas in an ordinary streptococcal infection the characteristic defense cell is the polymorphonuclear leukocyte, in erysipelas the cellular exudate is mainly composed of small mononuclears.

It appears that the presence of lymphocytes and the excellent effect of x-rays in treating the condition may in some way be associated. This would be in accord with other conditions, even of more chronic nature, associated with lymphatic hyperplasia which respond favorably to irradiation.

In erysipelas we have an excellent disease to demonstrate the ability of x-rays to lessen the toxemia, localize the infection, lower the temperature, slow the pulse and respiratory rates, minimize the complications and shorten the course.

Contagion.—Early reports on erysipelas stressed the fact that it is highly contagious; but current methods of handling the

disease have eliminated this to a great extent. However, no chances should be taken. The patient should always be isolated, and no intern from the surgical or obstetric services should ever be allowed to serve a patient having this infection. This rule should also apply to nurses and all other attendants.

Relapses.—The history of this infection proves that an attack does not confer immunity. One who has had it should always be on the alert for a reappearance of the disease. A recurrence may even take place a few days after temperature has returned to normal, and relapse should be guarded against until the patient has fully regained his normal strength and routine of living. No claim is made that any immunity is established through x-ray therapy, but to our knowledge, no patient has ever had a recurrence after having recovered from an attack which was treated with x-rays.

Complications.—Nephritis and endocarditis are probably the most common and serious visceral complications, although meningitis may occur from extension from the face. Large doses of serum may place a serious handicap on the skin and the kidneys if an anaphylactic reaction occurs.

The water intake and, particularly, the urinary output should be observed carefully and be recorded on the chart. Erysipelas often develops in the aged patient, and if serum adds an extra hazard to the aged diabetic in whom a gas bacillus infection develops (p. 147), it may also be an added hazard to the aged patient who has erysipelas. At any rate, when x-rays have been given therapeutically for erysipelas we have not found it necessary to use serum.

Prognosis and Mortality.—Uncomplicated erysipelas, except in the aged and the very young, with hospital care and conservative treatment should not have a mortality rate over 5 per cent. In the young and in the aged, erysipelas can readily develop into a serious condition, and the mortality may go as high as 15 or 20 per cent.

Treatment.—The dangers from the use of serum are uncertain, but the dangers from the use of the x-rays do not exist in any appreciable degree if the treatment is given as recommended, under the direction of a radiologist.

If x-ray therapy is available, it should be used and no serum given; but if it is not available, specific serum should certainly

mortality in this group of lesions is high; mortality is low when they are treated with x-rays, and it immediately becomes high again when surgery and x-rays are combined.

X-rays will localize these infections in a large percentage of cases, and the prognosis, although guarded, is definitely better with x-ray than with surgical treatment. In the selection of technical factors, adequate kilovoltage must be used to penetrate the bony structures of the face and the base of the skull so that any extension of the infection along the lymphatic tracts may be irradiated while the primary areas of infection are receiving radiation. Sufficient filter to protect the skin is essential. A treatment with a divided dose, one part with heavy filter and heavier kilovoltage, and the other part with light filter and less kilovoltage, may be given. For instance, a total dose of 60 r may be divided as follows: 130 kv., 40 r with 4 mm. Al and 100 kv., 20 r with 1 mm. Al filter. This will permit a greater proportion of the heavier dosage to reach the deep structures, while most of the lighter dosage is absorbed superficially.

INFECTIONS IN ATHLETES

What appears to be a minor infection in an athlete may occasionally prove to be disastrous. This is true from the high school student to the seasoned professional, physically fatigued after long periods of close training and competitive effort. The minor infection in this type of patient should, therefore, be taken seriously, regardless of whether it is a simple boil or a small area of cellulitis following a floor or mat burn, because generalized septicemia develops too often to take any risk. The patient should be treated promptly and adequately with x-rays and forced to rest until the lesion is well on the road to recovery. We find magnesium sulfate packs useful locally in these conditions, in conjunction with x-ray. Rest is essential.

HUMAN BITE

Another type of lesion which is serious from the beginning is a human bite. Irradiation should be started for prophylaxis whenever possible (see Case 53, Fig. 87).

We have had 100 per cent recovery of patients with human

bite and almost the same score in the preservation of tissue. It has never been necessary to amputate any structures when x-ray therapy was started early. The statement that x-ray treatment is not effective in human bites is an error, if the technic we

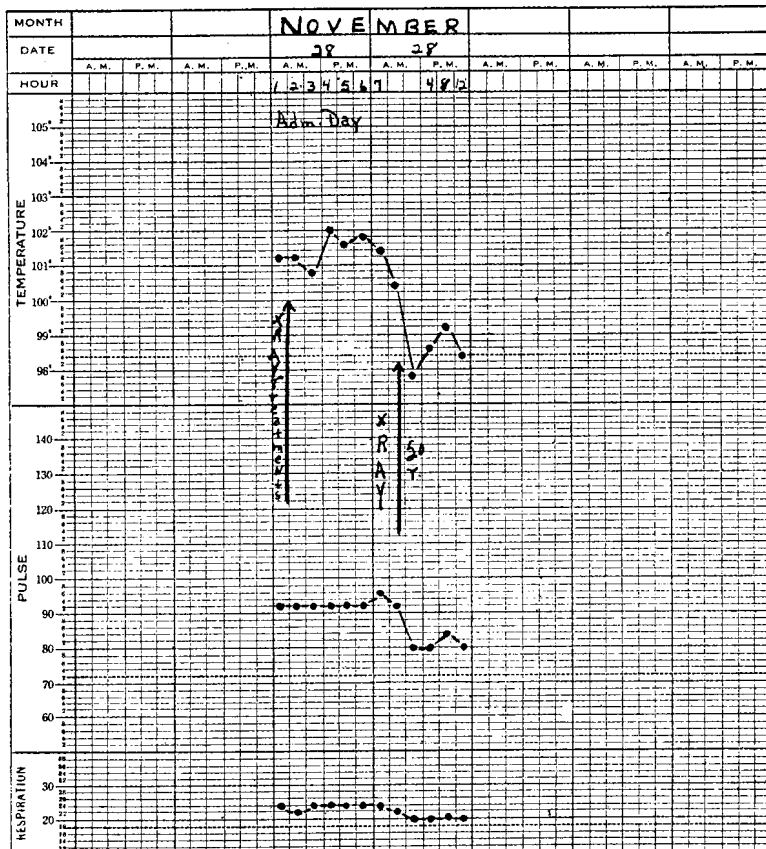


FIG. 87.—Case 53. Response was quite dramatic; the quick release from the hospital, is a matter of economy that cannot be overlooked. Cases of human bite are supposedly not responsive to x-ray therapy, but if the right dose is given, they definitely respond to irradiation. Technical factors were: 90 kv.; 5 ma.; 30 cm. distance; 1 mm. Al filter; side of face and neck as port. Result was excellent.

recommend is used. It is ineffective if incorrect technic is used, but the low voltage, low filtration, small dose and short space factor technic gives satisfactory results. Extensive débridement and other radical treatment are not indicated. If necessary, sur-

gery can be done after the infection subsides. The sulfonamides and radiopaque dressings must be avoided. Epsom salt packs are used in conjunction with the x-rays.

CASE 53.—P. M., a man aged 23, a professional wrestler, was admitted to the hospital with a painful swollen ear, headache, fever and malaise. He gave a history of having been bitten by an opponent during a match two days before. The temperature was 101.2 F., pulse rate 92, respiratory rate 24 and white blood cell count 9,250. Clinically, this condition looked like a streptococcal cellulitis involving a large cauliflower ear and the adjacent cervical region. An x-ray treatment was given immediately after admission. He was treated the next morning and left the hospital late that evening with temperature normal (Fig. 87). He had no further trouble. The patient received no sulfanilamide.

Infections from human bites have been treated successfully with x-rays since the year of their discovery by Roentgen. This fact is still ignored by many clinicians.

LUDWIG'S ANGINA

In the few cases given x-rays, our results have been excellent. In some instances, surgery was unnecessary, the process undergoing complete resolution with radiation therapy. Two or three treatments each day, with 120 kv., 3 to 4 mm. Al filter and 40 to 50 r per treatment, if three treatments are given, are recommended. From 120 to 200 r per day is indicated.

RECENT EXTRACTIONS

We have occasionally used x-rays in treating swollen, painful jaws following the extraction of teeth when there was no evidence of Ludwig's angina. Irradiation has never failed to lessen the pain and hasten the reduction of the swelling. This procedure is most helpful to the patient who has just had a tooth extracted. When used in this way, x-rays may be considered a prophylactic agent against extension of the infection as well as an analgesic. They definitely shorten the period of convalescence and minimize the chance of a serious complication.

FRACTURED JAW

X-ray treatments may be administered immediately after a fracture of the jaw to lessen the pain and hasten reduction of the

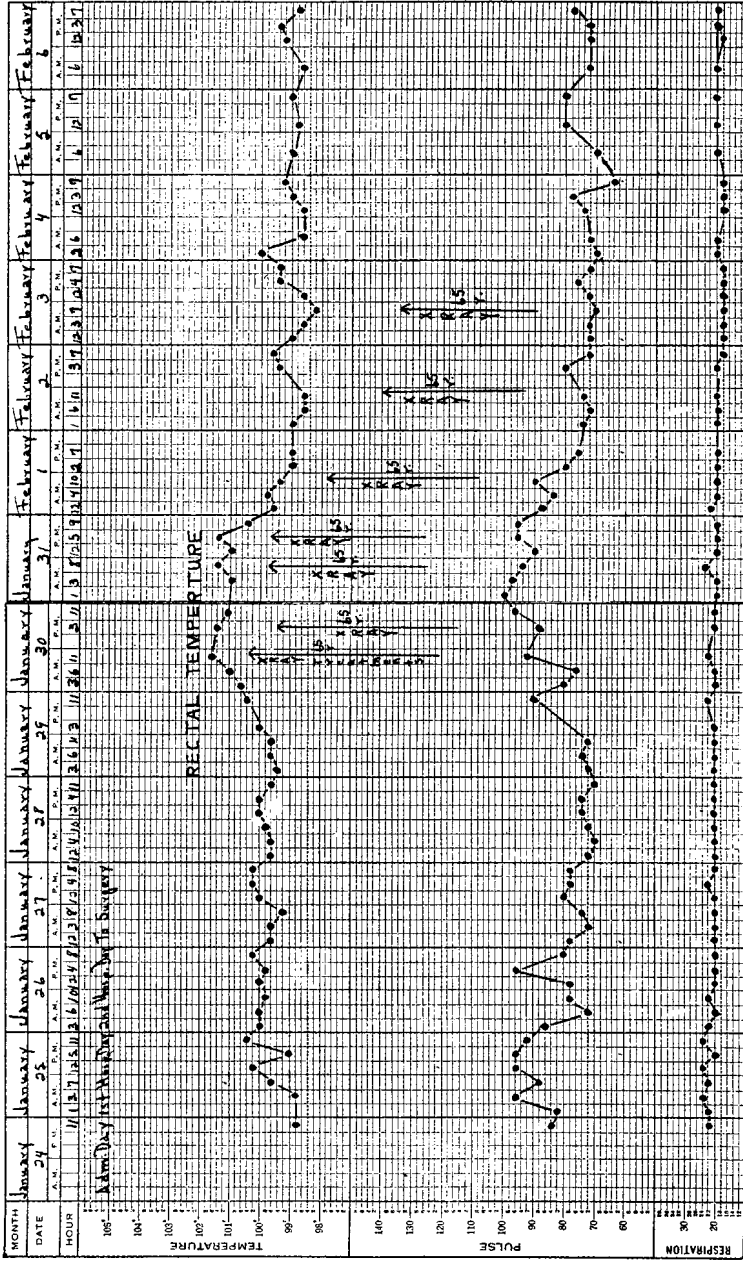


FIG. 88.—Case 54. Despite a late start in x-ray therapy, prompt response occurred. Technical factors were: 100 kv.; 5 ma.; 50 cm. distance to the jaw and 40 cm. distance to the arm; 2 mm. Al filter; right jaw and left arm as ports. Result was excellent.

swelling. In this condition, they may be of great help in preventing a serious infection, particularly in the bone, as osteomyelitis is occasionally a distressing complication of this injury.

CASE 54.—C. P. W., a youth aged 19, was admitted to the hospital February 24, 1939, three hours after he had received a compound fracture of the right side of the jaw. On the third hospital day, the fracture was reduced and wired. Three days later the temperature was 101.6 F. X-ray therapy was given over the right side of the jaw and neck. The following day cellulitis developed in the left arm at the site of a hypodermic injection. The left arm and shoulder as well as the fractured jaw were then treated until the seventh postoperative day, at which time the temperature reached normal (Fig. 88). Convalescence was rapid. No sulfanilamide was given. Osteomyelitis did not develop.

The treatment of an infection following a hypodermic injection should begin with the first signs of inflammation. If a gas bacillus infection is suspected, an x-ray film should be made. Simultaneous treatment of two different infections with equally good response makes Case 54 somewhat unusual.

NAIL PUNCTURE

CASE 55.—J. C., a man aged 45, was admitted to the hospital March 26, 1939, complaining of pain in the right leg with fever and chills of 10 days' duration. The temperature was 104 F., pulse rate 104, respiratory rate 22 and white blood cell count 14,800. There was a history of a nail puncture wound of the foot two weeks previously. Hot packs of magnesium sulfate and x-ray therapy were ordered. The first x-ray treatment was given four hours after admission, and one each day for three days, making a total of four treatments. The temperature began to drop immediately after the first treatment, and was normal the last two days of hospitalization (Fig. 89). He received no sulfanilamide. The patient returned home and has had no further complications.

X-ray therapy seemed to be of immediate aid in this case and undoubtedly cut down the period of hospitalization. The temperature and white blood cell count at the time of admission suggest that this infection might easily have developed into serious proportions with a long period of suppuration and disability had it not responded as promptly as it did. Often a trivial infection, if neglected, leads to considerable loss of time from work and occasionally may result in some permanent disability. Early x-ray therapy at short intervals seems effective.

X-RAY TECHNIC

The exact x-ray technic to be used in the foregoing group of acute lesions cannot be given in fixed terms because they vary so much in their requirements, but the factors will be stated in a general way.

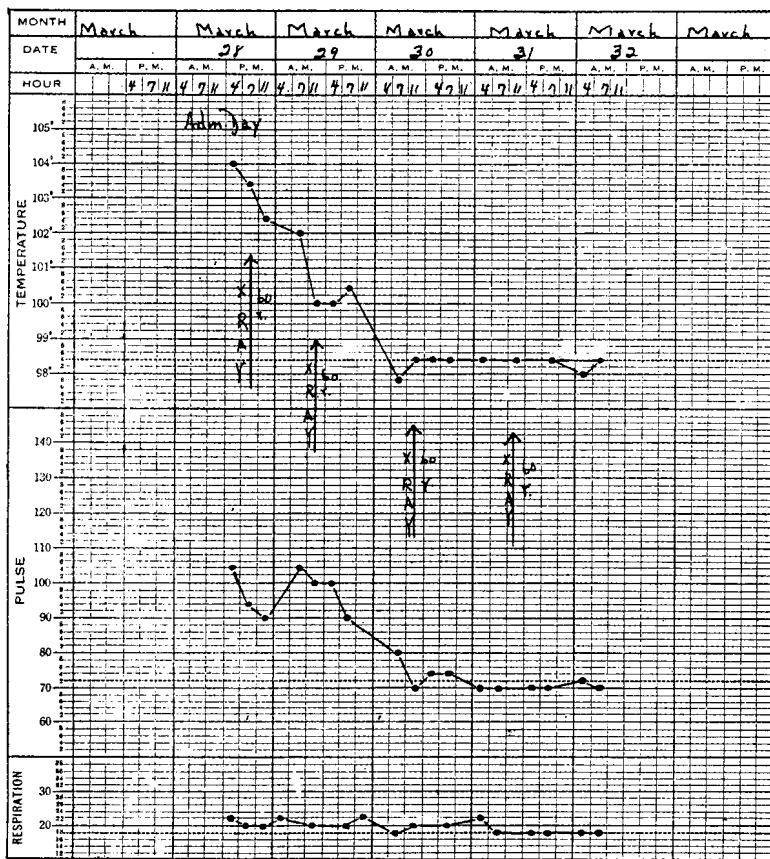


FIG. 89.—Case 55. Drop in temperature and pulse rate will compare favorably with similar responses ascribed to chemotherapy. No dangerous or unfavorable sequelae follow irradiation. Technical factors were: 100 kv.; 5 ma.; 40 cm. distance; 3 mm. Al filter; foot and ankle as port. Result was excellent.

Kilovoltage.—This must be sufficient to penetrate the area involved—between 90 and 130 kv.

Filter.—Two densities of filter in a divided dose may often be

required for active infections in two planes or in two densities of tissues. The lighter filter permits greater external absorption; the heavier protects the outer structures and skin while delivering a greater amount of radiation to the deeper structures.

Distance.—This should be 40 cm.

Size of Port.—The port should be large enough to cover the entire area involved and some margin of apparently normal tissues. If the port is exceedingly large, one should lower the dose per treatment and also the total dosage.

r Units per Dose.—The number of r units per dose varies from 40 to 75, depending on the clinical requirements of the case and the number of treatments to be given each day. If only one dose per day is given, use the larger number of r units; if two or three treatments are given per day, lower the number of r units per treatment accordingly.

Space Factor.—The frequency of the treatments will depend on the toxic manifestations, the amount of pain and the tendency of the infection to spread—usually one or two treatments each day. With a serious complication such as a cavernous sinus thrombosis, three small doses each day may be indicated.

Total Dosage.—The total dosage is 500 to 600 r units over a period of five to six days. The daily dosage, with its accumulation and simultaneous loss from the tissues, must be carefully calculated and recorded, since in some of these diseases reactivation of infection is common and additional dosage is then required. Especially is this so if treatment is terminated prematurely. The limits of safe dosage in the second series must be ascertained as accurately as possible.

When in doubt, increase the filter or lower the dosage, or do both. If serious trouble is anticipated from an error in dosage or from the use of some other therapeutic measure which may accentuate the action of the x-rays, such as the application of tincture of iodine, do not give more x-ray treatments until a few days or sufficient time has elapsed to judge the extent of the oncoming reaction.

SUPERFICIAL OCULAR INFECTIONS

We have had little experience in treating acute inflammatory conditions affecting the eyes, as most of these processes respond

promptly to local treatment in the hands of the ophthalmologist. However, occasionally a patient with stubborn conjunctivitis has been referred and treated with 100 kv., 75 r units, 1 mm. Al filter once each day for three or four days. This is the limit of dosage we have given to the eye and is administered through the closed lid. Several cases of hordeolum have been successfully treated with the same technic. Hot boric packs and the usual other measures were used at the same time. A few stubborn cases of blepharitis have also been treated with prompt response. These required large dosage, as seen in the following cases.

CASE 56.—J. J. M., a man aged 65, had chronic blepharitis for many years, but in the past few weeks it had become quite severe. X-ray therapy was started, and he was given three doses of 75 r units and three doses of 50 r units at three day intervals. Recovery was complete and permanent.

CASE 57.—J. H. M., a man aged 53, was referred by an ophthalmologist who had been treating him for two months for a persistent blepharitis. X-ray therapy was given as follows: 110 kv., 60 r units without filter for two doses, and 80 r units with filter for five doses at four day intervals, at 30 cm. distance. The condition was greatly improved after the first two treatments, and the succeeding treatments with filter were given to prevent a relapse. There has been no recurrence.

It will be noted that treatment is seldom recommended in these pages without some filtration. Blepharitis and impetigo are among the occasional exceptions.

IMPETIGO

CASE 58.—J. V. K., a boy aged 8, had had several attacks of impetigo on the mouth and chin. He was treated with 110 kv., 30 seconds, no filter, 40 r units each dose, given daily for three days. From this point on, as a safety factor, a 1 mm. Al filter was added and a four minute treatment was given every third day for three doses. This was effective in clearing up this stubborn minor infection.

ACNE

Acne in its various forms has been treated with such success during the last 25 years that x-rays are now looked on as essential in the treatment of this disease.

We have followed a simple technical procedure, giving from 100 to 140 r units every five to seven days and reducing the

dosage as the lesions disappear after five to seven doses. Many authorities treat acne without filter, but the technic we use always includes filter.

We feel that by observing the following precautions we have avoided damage to the skin: (1) Never treat without filter; we always use 1 mm. of Al. (2) After giving five to seven doses of about 150 r units with a five-day space factor to large areas of skin, restrict treatment to single lesions or a small group of lesions. (3) Never carry the x-ray dosage to a point where it causes visible reaction. (4) In younger patients, be particularly careful to use small doses; if the lesions fail to respond after five to seven doses, we give no further x-ray therapy for some time.

Acne is not such a serious disease that a young person should be exposed to any risk of radiation damage to the skin in order to secure relief. A conservative series of x-ray treatments, that is, small doses at long intervals, has a favorable effect, and it is sufficient in many instances to secure relief until the disease entirely disappears. In the more stubborn case, constitutional and local measures as well as some deviation from the usual course of x-ray treatments may be indicated. No irritating local applications should ever be applied to the areas of skin to which x-ray therapy is being directed. Likewise, no radiopaque powders, ointments or solutions should ever be present on the skin when x-ray treatments are given. If, at any time, it is felt that the patient may be receiving too much x-ray therapy, treatment should be interrupted immediately. If there is any doubt about any factor in the treatment, omit the treatment. All the present-day textbooks on the skin, particularly MacKee's,⁴ give excellent and detailed consideration of the roentgen therapy of acne and should be consulted if the reader wishes more complete directions regarding the treatment of certain types of acne, some of which respond poorly to radiation.

The addition of small doses of desiccated thyroid ($\frac{1}{2}$ gr.) daily has an excellent influence in certain cases. Attention to the patient's weight, metabolic rate and circulatory system are necessary if thyroid is given. The cooperation of an internist is often necessary.

CASE 59.—J. D. J., a man aged 24, a medical student, for 12 years had had acne which had been much worse in the past three years. He was very conscious of it and had tried everything but x-ray therapy.

An examination revealed that the basal metabolic rate was plus 19.

Examination revealed a diffuse nodular and pustular type of acne involving the face, forehead and sides of the neck. He was treated with 110 kv., 1 mm. Al filter, 30 cm. distance, 5 ma., for 4 minutes, giving 160 r units. This dose was repeated three times at four day intervals. It was then reduced to three minutes (120 r units), and this dose was given five times at four day intervals. There was marked improvement and no further treatment was required.

This patient had been told that x-ray therapy would do no good, but the nodular and pustular type of acne has responded favorably in our hands.

CASE 60.—W. J. R., a youth aged 18, was referred for treatment of facial acne of one year's duration. Lesions were mostly of the pustular type, with involvement of the forehead, cheeks and chin. Treatment was started November 23, 1929, with 110 kv., 30 cm. distance, 1 mm. Al filter, 120 r to each side of the face. This was repeated at four day intervals for a total of eight treatments. Response was slow, but improvement was fairly steady, and after the eight treatments therapy was discontinued for six weeks. Then individual lesions or localized areas of involvement were treated as they appeared. Eleven treatments were given during the ensuing six months, and during the year since then the skin has been in excellent condition.

CASE 61.—H. A., a youth aged 20, was referred for treatment of acne of three years' duration. The lesions were of the large pustular type involving the forehead, nose and chin. Treatment consisted of 160 r at weekly intervals for a total of 11 treatments. All treatments were given with 110 kv., 30 cm. distance and 1 mm. Al filter. Improvement was noted after the second treatment and continued until the condition was excellent and the patient dismissed.

CASE 62.—S. K., a woman aged 24, was referred for therapy of a fine papular type of acne of the forehead region of one year's duration. She was treated three times at five day intervals with 110 kv., 1 mm. Al filter, 75 r per treatment. There was some improvement. She failed to return for three months, at which time all of the gain was lost and the chin and cheeks were becoming involved. Basal metabolic rate was minus 22. Three x-ray treatments were given at six day intervals, using 110 kv., 120 r units and 1 mm. Al filter. During this time, she also took desiccated thyroid, $\frac{1}{2}$ gr. daily. Response was prompt, and the skin was in excellent condition at the end of treatment.

DERMATOMYCOSES

During the last few years, much has been learned about the various fungi which are pathogenic for the skin and nails of certain individuals. The majority of the eczematoid lesions

caused by these organisms respond well to small doses of radiation given with a four or five day space factor. When a case is encountered which fails to respond, a source of reinfection should be sought. Also, a thorough search for etiologic factors and a review of the radiation dosage are indicated. Areas involved over long periods will, of course, return to normal more slowly. The chief problem in these conditions is their tendency to recur.

The hands and feet, particularly the toes, and the folds of skin under the breast, the perineum and the axilla are the areas most frequently requiring treatment. It is unnecessary to carry the radiation dosage to a point of visible reaction.

Dosage similar to that used for eczema under the breast is effective and should be used for eczema around the nipple and for fissured and infected nipples in nursing mothers. A daily dose of 60 to 80 r with 110 kv., 1 mm. Al filter over the involved area for three days should suffice, but it may be necessary to carry it beyond that point. More filter may be added and the kilovoltage increased if an abscess deep in the gland is suspected.

CASE 63.—C. M. K., a man aged 30, was referred for treatment of an eczematoid fungous involvement of both feet and the right hand which had failed to respond to topical therapy during a three month period. The lesions showed large numbers of small blebs, referred to as "water blisters" by the patient.

The patient was treated every second to fourth day with 120 r units at 110 kv. through a 1 mm. Al filter. After the ninth treatment, the areas showed no evidence of disease. There was no recurrence.

This group of conditions is treated more or less intensely, as required by each individual case. Two or three treatments are given after all evidence of the disease has disappeared. These supplementary treatments are given at longer intervals; occasionally a smaller number of r units is given if only the skin is involved. When the nails are involved, a long series of treatments with added filter (2 mm. Al) is usually required.

CASE 64.—J. P. D., a woman aged 30, had severe epidermophytosis similar in appearance to that in Case 63, involving the toes and interdigital areas of the right foot. Secondary infection and swelling of the foot were such that the patient had been unable to wear a shoe for the past two weeks. She received seven treatments with 110 kv., 30 cm. distance, 1 mm. Al filter, 5 ma., 120 r units, anteroposteriorly and postero-anteriorly for each dose at three day intervals to the involved regions. After the seventh treatment she was dismissed clinically cured.

PLANTAR WARTS

Plantar warts, painful hard corns and bunions and soft corns can be treated successfully with x-rays. The bunion and the corn will not be entirely removed, but the pain can be relieved. The wart and the soft corn, if treated properly, can be entirely removed. All these conditions require the same x-ray technic.

CASE 65.—L. K., a man aged 28, was referred for treatment of a persistent plantar wart of six months' duration on the ball of the left foot. He was given 300 r units with 2 mm. Al filter, 110 kv., 30 cm. distance at five day intervals. He was dismissed after the seventh treatment and has remained well.

CASE 66.—A. N., a youth aged 17, was referred for treatment of a tender plantar wart on the right heel. He was treated every five days for eight treatments. The dose varied from 160 to 240 r with 110 kv. and 2 mm. Al filter. The soreness was gone after the third treatment and the skin was smooth after the eighth treatment.

CASE 67.—W. S. was referred for treatment of a tender plantar wart on the ball of the right foot which had been present for many years. She had had considerable treatment of various kinds, including cautery. The duration and the scarring incident to other forms of therapy made response to x-ray slower than usual in this type of case. The patient received a total of 13 treatments with 110 kv., 2 mm. Al filter once each week, the dose varying from 120 to 200 r units each, before the wart finally disappeared. The pain was greatly decreased after the second treatment. She has remained well.

THE GRANULOMAS

The small doses of x-rays recommended for the acute infections should do no harm to any of the irradiated tissues. But for the more chronic infections associated with granulomatous lesions, the more extended irradiation required may give rise to a state of lowered resistance in fibrosed tissues and some harm may result, especially if a secondary, rapidly progressing infection sets in. One must be a judge of radiation effect on tissues before attempting to treat the diseases caused by slowly growing organisms such as blastomycosis, actinomycosis and other fungi, as well as tuberculosis of the glands and infections of that general type. They are much more difficult to treat successfully than are the more acute, more toxic and more fulminating groups. Since they are of no immediate danger to life, they do not require emergency treatment by a novice. Therefore, since they require

The enlarged glands in children are usually radiosensitive, and prompt improvement is the rule.

X-RAY TREATMENT OF THE NASOPHARYNX

We have had some experience with extensive infections of the nose. X-ray treatments were requested, and treatments were given immediately. At the same time, a specific cause for the lesion was suspected. In two of such instances, diphtheria was proved to be the cause. In another, a lesion on the upper lip proved to be a chancre. As far as could be ascertained, no harm came from the few x-ray treatments given while the exact etiology was still in doubt. In each instance, x-ray therapy was discontinued and specific therapy was instituted. These cases are included to bring out the fact that every infection treated with x-rays should be diagnosed as early and as accurately as possible.

There is no good reason why x-rays should be used for the treatment of any disease for which there is a specific serum as highly efficient as that for diphtheria or a chemotherapeutic régime as effective as that for syphilis.

When the disease fails to respond to specific therapy, however, as in the case of the diphtheria carrier, it may be justifiable to resort to radiation therapy. Although we have had little experience in the x-ray treatment of diphtheria carriers, its successful use has been reported in the literature by reliable authorities.

We have emphasized the fact that it has been established clinically and experimentally that lymphatic tissue is highly sensitive to irradiation. Despite this, we have never made it a practice to substitute radiation therapy for surgery in the treatment of infected tonsils.

DIPHTHERIA CARRIERS

There may be exceptions to the foregoing procedure, such as the patient who is a serious surgical risk or one who has some organism which is highly sensitive to irradiation. This appears to be the case in the chronic diphtheria carrier. We have just stated that irradiation should not be given in acute diphtheria because toxic symptoms are present and the antitoxin is certainly preferable. However, experience has proved that the organisms disappear in the diphtheria carrier if the tonsils and pharyngeal

areas are irradiated. Since there is no danger associated with x-ray treatment and it seems to be effective, no objection should be entered.

This discussion serves only to impress one with the fact that, as the practice of radiology is the practice of medicine, no hard and fast rules can be laid down. Each case offers an individual problem, and all the factors entering into etiology and pathology must be considered before making the final selection of the method of treatment for the case at hand.

Certainly, the great majority of patients with diseased tonsils do well with a properly managed tonsillectomy; in our opinion, surgery is the method of choice, but there are exceptions. A persistent ear infection or bronchitis after the tonsils have been removed may be sufficient reason to irradiate the area of secondary involvement as well as the tonsil region. Many of our leading pioneers in roentgen therapy contributed to the knowledge of treatment of the eye, ear, nose and throat. For accurate diagnosis of the diseases of the mastoids and sinuses, we are indebted particularly to Law.¹² For a most complete discussion of x-ray therapy of the eye and ear one should consult the chapter written by DesJardins in Pohle's *Clinical Roentgen Therapy*.¹³

In 1922, Hickey made a preliminary report on his observations on the diphtheria carriers he treated in Detroit. He included some unofficial data from other radiologists in the Middle West concerning the treatment of 200 diphtheria carriers, resulting in the disappearance of the diphtheria bacilli in a large percentage of cases. Regarding technics, Hickey stated:

In the throat cases, that is, those where Klebs-Loeffler bacilli were found in the pharyngeal secretions, the line of roentgen ray treatment was similar to that recommended by Witherbee in cases of tonsillar hypertrophy, the treatment being given over each side of the neck, the central rays being directed toward the tonsils. The dosage employed was similar to that used for the treatment of tonsillar hypertrophy. In the nasal cases, the roentgen ray treatment was given directly over the nose, and in the ear cases, over the mastoid area of the ear which showed Klebs-Loeffler bacilli in the discharge.⁷

The next report was made by Kahn¹⁴ in 1924, who reviewed the work which he previously reported in 1922. He claimed excellent results with the following technic: 5 ma., 10 in. focal skin distance, 7 in. spark gap, filtered through 3 mm. Al filter. He never found it necessary to use more than a four minute exposure,

which he estimated at one-third an erythema dose and stated that the dose could be doubled or even tripled without crossing the danger threshold. In our opinion, the size of the port would have a bearing on the limit of radiation given for the condition, but even a fairly large port over the tonsillar area might tolerate double the four minutes. The kilovoltage which Kahn suggests is quite close to 120 kv. and with 3 mm. Al, 400 or 500 r units should be quite effective, judging from his results.

Another successful technic was reported by Dubowyi:¹⁵ 210 kv., 4 ma., 0.5 mm. Cu and 2 mm. Al, focal skin distance 25 cm., to fields over the nose and tonsillar region, about 4×5 cm. in children and 5×6 cm. in adults, giving 20 per cent (128 r) to children up to 5 years, 25 per cent to children between 5 and 10 years (160 r), 30 per cent to children from 10 to 15 years and after that age one-third (215 r), allowing 640 r units for one erythema dose. This dosage is given in a single session.

CASE 70.—D. T., a girl aged 19, was confined to the city isolation hospital for several weeks following an acute attack of diphtheria because repeated cultures of the throat showed she was a diphtheria carrier. There was resistance to all local and systemic treatment, and finally x-ray therapy was given. The factors used were: 160 kv., 0.25 mm. Cu and 1 mm. Al filter, 10 ma., 60 cm. distance, 100 r to each side of the neck every third day for four doses. The culture was negative after the second treatment, and it remained so.

SINUSITIS

When Osmond¹⁷ first reported his experience in the x-ray treatment of sinusitis, he was promptly placed under suspicion and even mildly criticized for suggesting such therapy. But today the radiotherapist who is not aware of the aid to be obtained from the use of x-rays in acute sinusitis and in some forms of chronic sinusitis is uninformed about progress in modern therapy.

We concern ourselves here with acute sinusitis—the early and late stages. The chronic forms require too much irradiation over a long period to be included in this discussion. They are, nevertheless, greatly benefited by irradiation, according to the reports of fine clinical results by Hodges and Berger,¹⁶ Butler and Wooley¹⁸ and others who have done pioneer investigative study in this field.

These clinicians stress the necessity for correct diagnosis and

proper classification of cases before radiation. Hodges, through careful study of the pathology, has contributed much to a scientific basis for the procedure. Those interested are advised to consult the original articles of these workers.

Patients with acute sinusitis may be greatly benefited by a few small doses of x-rays given with a short space factor without approaching a total dose of any great intensity. As in many other acute infections, x-rays lessen the toxemia, slow the rapidity of the invasion, localize the process and minimize the clinical severity of the disease. In general, x-ray treatment shortens the duration of the attack and thereby lessens the possibility of complications, reducing the morbidity to a minimum.

MENINGITIS

Schüle's²⁰ report on roentgen therapy of epidemic meningitis may be of interest; we have not had the opportunity to treat this disease. Schüle found reports in the literature of seven cases in which cure was obtained by use of x-rays. All patients were treated with small or moderate doses. In the one case Schüle reported, the following technic was used: 180 kv., 165 r, 0.5 mm. Cu, 4 ma., to the temporal field, 10 × 15 cm., for one dose. The patient was clinically well one month later.

ACTIVE RHEUMATIC HEART DISEASE

Levy and Golden³⁰ treated active rheumatic heart disease with 200 kv., 0.5 mm. Cu and 1 mm. Al filter, 50 cm. distance, 60 r units anterior and 100 r units posterior to the heart area. They attempted to deliver 60 r units or one-tenth erythema dose to the heart. If a systemic reaction occurred, smaller doses were given. Four treatments were given with a two week space factor between treatments. The series was repeated in one to three months. Twenty-five of their 48 patients were improved. Their report covered a study of 11 years. Anyone interested in this problem should consult the original article for more complete details.