

A THESIS ON  
"ERYSIPELAS: WITH SPECIAL REFERENCE TO OLD AND  
NEW TREATMENT".

submitted for the M.D. degree

by

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Oct. 1931.



## INTRODUCTION

Much has been written and continues to be written regarding the treatment of erysipelas, each new remedy enjoying a passing popularity, only to be discarded in favour of the next. The mere multiplicity of methods itself testifies to their inefficacy, or their lack of universal applicability, and indicates the need for further experiment.

Local applications, used empirically, have largely given place to attempts at specific therapy, mainly in the form of serums and vaccines: this would appear to indicate a distinct advance, but although striking results have been claimed by various workers in this field, it is generally admitted that wide variations in the response to antitoxin and vaccine therapy exist. Many clinicians after exhaustive trials of the various methods at present in vogue, have been compelled to agree with the dictum of Trousseau, who held that expectant treatment offered most advantages.

Under these circumstances the writer feels justified in submitting records of the following cases, and advocating on their basis the early employment of ultraviolet radiation, as a means by which cases, particularly those at an early stage, may be

advantageously treated. The series consists of 51 cases, for the most part consecutive, treated at the Edinburgh City Hospital, during the period November 1930 - May 1931. In a few cases admitted during that period this form of treatment was not attempted, either because the disease at the time of the patients' admission appeared to be already in the recovery stage, or because the duration and extent of the lesions rendered the local application of light impracticable, e.g. where the spreading edge was already under cover of the hair.

Ultraviolet radiation has been used in a great variety of pathological conditions, applications being generally over a wide area of the skin surface for repeated short periods. In the present series of cases, the short-wave technique has been employed, a marked, dermatitis-producing dose of quartz rays being superimposed on the already inflamed, erysipelatous area, one application generally completing the treatment. This was not, as it might seem, the acme of cruelty; the patients suffered little or no added discomfort, and in the great majority of suitable cases within a few hours of the application the pain and swelling began to subside, and a few hours later the temperature commenced to recede. This method of treatment is cleanly, easily and quickly applied, and appears to secure good results with a minimum of discomfort, danger and expense. The total duration of the illness was shortened, although not to a very

marked extent, and, more important, the patient's discomfort was considerably lessened.

It is a well recognised fact that the disease is most prevalent in cold, damp weather. Chilling of the skin surface, doubtless, reduces the blood-supply to the part, and may in that way lower the resistance. In view of this it seems rational to attempt to raise the resistance by the establishment of an artificial hyperaemia.

In a disease such as erysipelas, which is so uncertain in its duration, it is extremely difficult to assess the value of any particular mode of treatment, and still more difficult to construct convincing statistics. "Control cases" are of necessity under suspicion, as no two cases can be expected to progress alike when untreated.

In some of the cases under consideration, the rapid disappearance of signs and symptoms may well have been post hoc and not propter hoc; in others, in which it was possible to tackle only one section of the spreading edge, the constitutional disturbance continued although the local treatment appeared to be successful where it was applied; in others the erysipelas was a complication of another infection, and any amelioration of symptoms which might have accrued from cessation of the former was obscured by a continuance of the latter.

## HISTORICAL OUTLINE.

The term "Erysipelas" dates back to the time of Hippocrates, who included under this name not only almost all acute inflammatory affections of the skin and subcutaneous tissues, but also various inflammatory conditions of the internal organs. He was nevertheless probably well acquainted with the clinical entity now described as erysipelas. He mentions in the 3rd book on epidemics that at certain seasons erysipelas became epidemic, and described its onset in wounds. Regarding etiology, Hippocrates mentions only certain meteorological conditions.

Galen distinguished clearly between "rose" and phlegmonous conditions, but on the other hand, often confused erysipelas with other skin diseases. He considered that the disease was due to a disturbance of the biliary secretion.

Callisen, in 1783, first gave a definition of erysipelas approximately coinciding with the modern clinical conception.

Rust, in 1832, drew a distinction between erysipelas and the rashes of the acute exanthemata and miliaria etc. but it was not until several years later that the contagious nature of the disease was recognised.

Huter, in 1880, thought he had found the causal organism in the "little actively-moving cocci" which



he described as occurring in the blood and serum obtained from the lesions. Later, Lukomsky, Billroth, Ehrlich and others described the occurrence of organisms in erysipelas, but it was left to Fehleisen<sup>1)</sup> in 1883 to discover and prove the causal relationship of the streptococcus. He described minutely the pathological condition found in sections of affected skin. After many failures he succeeded in isolating a haemolytic streptococcus which he called "streptococcus erysipelatis", by incubating in a gelatin medium, and later in coagulated blood serum, an excised portion of affected skin. Inoculation of this streptococcus into the skin of rabbits resulted in the production of typical erysipelatous lesions, but the final proof of its causal relationship to erysipelas in man was the result of his attempts to produce an "erysipelas salutaire" by direct inoculation of the organism into the skin of sufferers from other maladies, in the hope of curing the latter. Fehleisen describes seven such inoculations, of which six were successful.

Fehleisen described in detail certain morphological and cultural differences between his "streptococcus erysipelatis" and streptococcus pyogenes, but these have not been upheld by subsequent workers in the same field, mainly on account of the results obtained by Marmorek<sup>2)</sup> in his experiments with streptococci of modified virulence. Most authorities are

now agreed that the streptococcus pyogenes and the streptococcus erysipelatis are identical, or have a group relationship, and that the type of lesion resulting from their inoculation depends on variations in the virulence of the organism, in the site of inoculation, and in the subject inoculated.

Recently, Dochez, Avery and Lancefield,<sup>3)</sup>  
 Tunnicliffe<sup>4)</sup> and Birkhaug<sup>5)</sup> have demonstrated by means of serological methods, a degree of type specificity within the large group of haemolytic streptococci. Birkhaug found that 91.2% of strains of haemolytic streptococci isolated from cases of erysipelas fell antigenically into one group, and that it was possible to differentiate by means of agglutination and absorption tests a group of haemolytic streptococci causing erysipelas from a group causing Scarlet Fever on the one hand, and on the other, from the larger series of miscellaneous haemolytic streptococci producing a variety of pyogenic infections.

F. L<sup>u</sup>lsdorf<sup>6)</sup> who records an illustrative case of staphylococcal erysipelas, states that Fehleisen's view that a streptococcus was the only causal agent of erysipelas was shown by subsequent observers to be incorrect. In 1901 Jordan reported two cases in which undoubted staphylococci gave rise to erysipelas as well as to suppurative osteomyelitis, abscesses etc. Typical erysipelas has been produced experimentally by Jordan, Felsenthal, and Petruschky with

staphylococci.

Previous to the introduction of antiseptic surgery, erysipelas was a very frequent and troublesome complication of operation wounds, outbreaks not infrequently being associated with one or more particular beds in a ward. Clean operation wounds, rather than those already septic, appeared to be most readily affected, and the weak state of the patient, and the probability of exhaustive suppurative complications, tended to increase the risk of such "surgical" cases. Modern asepsis has practically eliminated the risk of surgical outbreaks, and the now customary isolation of both "surgical" and "medical" cases has had the effect of rendering the disease, once so common, comparatively rare.



(7-13)

ETIOLOGY, COURSE ETC. OF ERYSIPELAS.

Distribution:- The disease is world-wide in its distribution, although less common in the tropics than in temperate or cold climates.

Predisposing Factors:- Season as a predisposing cause is of more importance than climate, the disease being generally most prevalent in cold and damp weather - in this country, from October to March. Any age may be affected, but the maximum incidence occurs between the ages of 40 and 50. Sex has probably no influence. Alcoholism and chronic debilitating diseases are predisposing causes, and finally, poverty, overcrowding, and bad hygienic surroundings generally, exert a like influence.

Etiology:- The lesion in the great majority of cases is due to a pure infection by the causal organism, the streptococcus, gaining entry through a breach in the epithelium. Such a breach is frequently microscopic and may even have healed before the onset of symptoms. Concomitant suppurative conditions are relatively uncommon.

Infection is by direct contact or fomites, but apart from surgical outbreaks, epidemics are rare.

The incubation period varies but probably 3-8 days covers the majority of cases.

Pathology:- Macleod <sup>7)</sup> gives the following description of the local lesion: "The microscopical appear-

"ances which are present in sections of a classical  
 "case of erysipelas are the histological evidences of  
 "the reaction of the skin and subcutaneous tissues to  
 "the streptococcus in situ, and consist mainly of a  
 "sero-fibrinous exudation and its consequences. More  
 "or less marked changes occur in the corium, subcutan-  
 "eous tissue, and epidermis, as a result of the  
 "presence of the streptococcus in the lymph channels.  
 "The blood capillaries are definitely dilated, and a  
 "serous exudation takes place from them: this may be  
 "so profuse as to separate the epidermis from the  
 "underlying papillary layer, and to form a flat sub-  
 "epidermal bulla ..... There is no marked leucocyte  
 "infiltration. A certain number of polymorph  
 "leucocytes are present, but are few in number in com-  
 "parison with those in a staphylococcal invasion, and  
 "indicate that the streptococcus and its toxins call  
 "forth a special type of chemotactic action, associat-  
 "ed with extravasation of serum rather than of  
 "leucocytes".

Course:- The onset is sudden and usually severe.  
 Shivering is a very constant symptom, followed by  
 a rapid rise of temperature and general malaise,  
 while headache and vomiting are common. Generally  
 the local lesion appears synchronously with these  
 symptoms, but its appearance may be delayed a further  
 twenty-four hours.

Erysipelas is much more common and typical in the face than elsewhere, starting generally either at the inner canthus of the eye or in the neighbourhood of a nostril. A patch of redness appears and spreads rapidly over the face. The affected skin becomes deep red in colour, swollen, and often shiny. It is tense, tender, and feels hot, and is definitely raised above the level of the surrounding parts, especially where the spread is most active. The patient suffers much local discomfort and toxæmia may be marked, headache, insomnia, and delirium being common. The rapidity with which the advance of the dermatitis takes place varies greatly in different cases, different areas, and at different stages, being generally most rapid where the subcutaneous tissues are most loose. The character of the subcutaneous tissue influences not only the rate, but also the direction and extent of spread, advance being slow and tending to complete arrest where that tissue is dense, e.g. at the edge of the scalp, and along the line of the lower jaw. In severe cases, blisters form on the affected surface. The tendency of the disease is to natural arrest, the affected area of skin generally healing in the course of a few days after a preliminary desquamation. There is no subsequent pigmentation. Such an arrest may take place at any stage, but if the dermatitis spreads from the face to the scalp or trunk its further progress is much more uncertain, as it may "wander" all over

the rest of the body, now rapidly, now slowly. On spontaneous resolution, the temperature, previously high and continued as a rule, falls, either by crisis, or more commonly, by lysis. There is a rapid improvement in the patient's general condition. This change may take place at any stage, but in the vast majority of cases, occurs by the 12th day of illness.

11)  
Ker states that 62% of his cases terminated between the 5th and 10th days. In only a small proportion of cases does the dermatitis "wander" from the part or limb initially affected - less than 10%. In these cases the fever generally assumes a remittent type, and spread is very irregular, both in regard to direction and rate.

Erysipelas has been described as occurring in practically all the skin and mucous surfaces, and may occur at all ages as a complication of operation or other wounds, or of other acute or chronic illnesses.

Complications, with the exception of abscesses, are relatively rare. They include broncho-pneumonia, acute nephritis, severe diarrhoea, meningitis, and pyaemia.

Relapses, occurring generally a few days after the original attack subsides, are fairly frequent, the immunity conferred by an attack being short-lived, but they are usually, though not invariably, of less severity than the original attack. 11)  
Ker quotes a rate of 4% in a series of 1643 cases.

Second attacks are even commoner, recurring usually in the same situation.

A chronic form of the disease is described lasting from a few weeks to a few months, following an acute attack.

Mortality:- The average case mortality is 4%-5% for all ages, but is much higher in infants, old people, and sufferers from chronic kidney disease, alcoholism etc., being over 25% in persons over 70. Twenty-five per cent of deaths occur in the first year of life, a large proportion of these being in infants under three months following umbilical infection.



## ACCOUNT OF VARIOUS METHODS OF TREATMENT OTHER THAN ACTINOTHERAPY.

There are few diseases for which a greater number of remedies have been recommended than erysipelas. This is the natural outcome of the fact that the tendency of the disease is to self-arrest, 90-95% of cases clearing up spontaneously after a period of illness varying from a few days to a few weeks, the temperature falling either by crisis or by lysis. This being the case, it is inevitable that in a proportion of cases treated by any means treatment should be followed within a day or two, sometimes within a few hours, by a cessation of symptoms, and it is not unnatural that in such cases the form of treatment adopted should get the credit, but each method suggested, while sometimes apparently successful, has so often proved useless that we are justified in regarding almost all of them with some scepticism.

General Treatment:- General treatment is of course a necessary adjunct to any other form of treatment, and here there is little need for controversy. The indications are obvious - to allay discomfort, maintain the resistance, and secure sleep. Suitable feeding, with an adequacy of the anti-infective vitamins A and D is essential. The internal administration of drugs,

apart from sedatives and cardiac tonics, is useless, although some authorities for long advocated iron, and the salicylates.

Local Treatment. The object of local treatment is twofold - to allay pain and discomfort, and to check the spread of the inflammation. With regard to the first of these, an application of lint soaked in a saturated solution of Magnesium Sulphate, and kept moist, has largely replaced the older remedies, such as lead lotion, evaporating lotions, ointments, medicated or otherwise, and dusting powders. Such an application is cheap, readily procurable, and easily applied, but to be efficacious it must be frequently renewed. Chalker<sup>14)</sup> recommends moist alcohol dressings, care being taken to protect the eyes.

The problem of limiting the spread of the dermatitis, unfortunately, presents greater difficulties, and it is here that so many remedies have been advocated, some so drastic that one might truly say that the patient recovers in spite of them rather than because of them. Firstly, various medicants have been applied to the inflamed surface. Of these, iodine, perchloride of mercury, perchloride of iron, glycerin, resorcin, ichthyol, and others have been tried without success. S. Kruger<sup>15)</sup> recommends a dressing containing Alcohol (96 per cent) 50 parts, and Sublimate (1-1,000) 1 part. Secondly, following the observation that the spread was less active and

tended to cease where the subcutaneous tissues were dense, attempts have been made to create an artificial barrier to the progress of the lesion by putting the skin ahead of the spreading edge on the stretch, or endeavouring to tack it down, by means of adhesive plaster, collodion, tight bandaging, etc. These again have proved useless. More scientific, though equally ineffective, have been the attempts to attack the causal organism directly. These have taken the form of the application of antiseptics, percutaneously, intracutaneously, or subcutaneously, immediately ahead of the inflamed part, where the organisms are most numerous. For this purpose, iodine, silver nitrate, and carbolic acid have been tried: in some cases actual incisions have been made in the healthy skin, and antiseptics rubbed in. Blistering fluid has been applied as a means of producing an artificial hyperaemia, but the method is not without risk.

Recently, X-ray therapy has been recommended, one or more exposures being made to the affected area and the surrounding skin, but so far, the evidence in its favour is scanty. E.S. Platon and L. Rigler<sup>16)</sup> have claimed striking results in cases treated by this means, and Jamieson and Hernaman-Johnson<sup>17)</sup> have recorded a few cases.

Specific Treatment. Many attempts have been made to produce an effective serum for the treatment of erysipelas, the earliest being those of Charrin and Roger in 1895. These workers used an anti-

bacterial serum, and for many years this form of treatment was persisted in without much success. Later, following the employment of streptococcus antitoxin in scarlet fever a fresh impetus was given to this form of treatment, and Birkhaug<sup>18)</sup> in 1926, reported good results with a preparation of antitoxic serum, although his cases were quite uncontrolled. He suggested an average dose of 15 ccs. of the concentrated serum, given early in the disease, intramuscularly. Later, Symmers and Lewis,<sup>19)</sup> and Musser,<sup>20)</sup> using much larger doses, waxed enthusiastic over serum therapy, the former writers concluding that "the antitoxin treatment marks an advance, the results of which are commensurate with those obtained in the treatment of diphtheria".<sup>21)</sup> Again their cases, as pointed out by McCann were inadequately controlled. The latter writer, in 1928 gave it as his experience that serum was of little value in the treatment of erysipelas. V. de Lavergne, P. Florentin, and H. Gousset<sup>22)</sup> as a result of clinical observation and experiments on rabbits came to the same conclusion.

Cushing<sup>23)</sup> in 1929 reported that "in no case of erysipelas of the trunk in an infant was any definite effect of serum noted", and pointed out that consistently good results cannot be expected until a sufficiently polyvalent serum is prepared, and exhibited early in the disease.

In a recent series of 68 cases, carefully con-



trolled, treated at the Edinburgh City Hospital with Erysipelas Streptococcus Antitoxin, the results were most unfavourable, the average duration of the illness being actually slightly greater in the serum-treated cases than in the control cases.

The fact that Scarlet Fever Streptococcus Antitoxin, in doses of 20 ccs. to 40 ccs. intramuscularly is being extensively tested in the treatment of erysipelas, again with markedly conflicting results, is of itself sufficient to condemn the anti-erysipelas sera so far prepared. Most authorities now tend to agree that the most that one can anticipate from serum therapy as practised at present is an amelioration of the constitutional disturbance, and that even this must not be too confidently expected. Certainly a serum, as a specific remedy, can be of little value if, following its employment, a marked spread of the local lesion occurs. This unfortunately, is all too often the case with the Erysipelas Streptococcus Antitoxins at present available. A.J.  
<sup>24)</sup> Schaffer and P.E. Rothmann treated 19 out of a series of 101 cases of erysipelas in infants and children by intravenous transfusion of whole citrated blood, and found that the mortality was distinctly lower than in the controls, but this method is obviously of limited applicability.

<sup>14)</sup> Recently, Chalier has strongly advocated the use of milk injections in erysipelas in preference to serum, basing his claims on his experience of over



1,000 cases. He reports good results in the treatment of facial cases in particular. He uses filtered milk, boiled, in 10 c.c. doses daily, for three or four days, the injections being preferably subcutaneous. He quotes, however, a list of contraindications to this form of therapy. Such results suggest that in many cases in which striking results have been ascribed to serum therapy, the improvement in the local and general condition has been due to the non-specific element in the serum.

Rivers and Tillett<sup>25)</sup> in 1925 suggested the intradermal use of immune serum as a means of arresting the spread of the dermatitis, the serum being injected in the form of a barrier ahead of the spreading edge. They claimed good results, and later<sup>17)</sup> Musser confirmed their findings, but as the method is clumsy, painful, and not generally applicable it has not found favour.

Erysipelas has been added to the long list of diseases in which vaccine therapy is recommended.<sup>26)</sup> Horder and Matthews suggest following up the intravenous administration of serum with "small doses of vaccine, preferably autogenous, on alternate days, for 4 to 6 doses". This, in most cases, is an impossible procedure. The majority of cases subside without any form of treatment, in less time than it would take to prepare an autogenous vaccine, and indeed in less time than it would take to administer a few doses of stock vaccine, unless these were given on consecutive days.

27)

Erdman in a long series of cases found that vaccine therapy had no effect in ameliorating the symptoms, shortening the illness, lessening the mortality, or preventing recurrence.

28)

More recently Benson as a result of a study of over 200 cases, adequately controlled, treated by stock and autogenous streptococcal vaccines, and by mixed staphylococcal and streptococcal vaccines arrived at a similar conclusion.

Theoretically, vaccine therapy would appear sound practice in subacute and "wandering" cases, but so far results have been unsatisfactory, even in these cases.

#### TREATMENT OF ERYSIPELAS BY PHOTOTHERAPY.

In conditions recognisable clinically as toxæmias due to microbic invasion, medical treatment aims solely at the stimulation of the natural processes of resistance to the organisms and toxins present, except in the few instances where a really effective antiserum is available. In ultraviolet rays, scientifically used, we have at hand an agent for such treatment, in that they act as a stimulus to the natural processes of defence. Obviously, to be effective, the rays must find in the tissues of the subject being treated some capability of responding to stimulation; if this is lacking, satisfactory results are impossible.

A single exposure of the unprotected skin to

a source of ultraviolet light is capable of causing a variety of changes in the skin, subcutaneous tissues, and blood. The main changes in the skin may be briefly summarised as follows. Given a sufficient dosage, the most noticable effect is the production of an erythema, which is the characteristic response of the skin to radiations from 2970-2500 A.U.

According to Lewis and Zotterman,<sup>29)</sup> the reaction of the cutaneous vessels consists of three parts, a local and active vasodilatation, a reflex dilatation of the muscular arterioles (little in evidence), and a locally increased permeability of the vessel walls. The result is chiefly evident in the deeper layers of the epidermis. There oedema occurs, mitotic cell division takes place, and there is an emigration of leucocytes. With more intense radiation, sufficient fluid is poured out to form vesicles. The true

skin shares to some extent in the oedema. Here we have almost an exact reproduction of the tissue changes which result in the skin following inoculation with the streptococcus erysipelatis, i.e. sufficient exposure of the healthy skin to a source of ultraviolet light calls forth the same type of chemotactic action as the streptococcus and its toxins, and it is only reasonable to suppose that the premature production of the natural reaction ahead of the spreading edge of the dermatitis will tend to check its advance.

In addition to the erythema there is usually some alteration of sensation, varying according to dosage,

from slight itching to actual pain.

The energy which rays possess then, is not lost when the rays are stopped by tissue absorption at varying depths according to the wave-length and kind of tissue. In addition to the chemical changes described above, certain thermal changes result.

<sup>30)</sup> Cumberbatch states that "short" rays of 2400-2000 A.U. do not pass the horny, dead, layer of epidermis, and have therefore no biological action; that the "medium" rays of 3200-2500 A.U. are responsible for the chemical effects manifested by the production of erythema, and that the longer ultraviolet rays (3900-3400 A.U.) expend their energy in heating the blood of the subepidermal capillaries. The visible rays penetrate further still, and heat the tissues more deeply, even to the superficial muscular layers under the deep fascia. <sup>31)</sup> Sonne, who investigated this latter point, found that the luminous rays are capable of heating the vascular structures in and beneath the skin, without any feeling of scorching, to a temperature which is several degrees higher than the maximum temperature ever measured with fever, and about 6°C. higher than the temperature it is possible to obtain at the same depth by irradiating with the maximum bearable quantity of heat rays. Such an alteration in temperature may well have a direct effect on toxins present or circulating in the part irradiated, if not on actual organisms present.

<sup>32)</sup> Dekeyser has pointed out that although tuberculin



like the tubercle bacillus in tissues is very resistant to short-waved radiations its toxicity is destroyed by ultra-violet light, and it may be that in the radiation treatment of lupus this selective action of light on toxins plays a part in cure.

<sup>31)</sup> Sonne has shown in the case of guinea-pigs that a light bath of visible rays for two hours following an otherwise fatal dose of diphtheria toxin enabled the animals to survive. In this connection one remembers that the exotoxin of the streptococcus erysipelatis is, unlike the Dick scarlatinal toxin, highly thermolabile, being destroyed at 55°C.

Lastly, radiation by activating ergosterol present in the skin initiates a mobilisation of available Vitamin D.

<sup>33)</sup> Colebrook, Eidinow and Hill, investigating the effect of radiation on the blood, found that there was a definite increase of the bactericidal power, the increase being most marked following an erythema

<sup>34)</sup> dose. Eidinow, by comparing the blood from a radiated and from a non-irradiated limb, came to the conclusion that this effect is resultant on changes occurring in the blood during its circulation through the radiated area. The latter observer states that an excessive exposure to actinic rays results in a <sup>35)</sup> decrease in the bactericidal power, and suggests that to obtain the maximum beneficial effect only a small area of skin should be exposed at one time.

<sup>36)</sup> He found later, in this connection, that suitable radiation of rabbits raised their resistance to subse-



quent injections of staphylococci.

Further, there is increasing evidence that scientific exposures to an artificial source of ultraviolet light is beneficial in a variety of acute infections, especially in cases which already show some degree of resistance.

#### LITERATURE.

Although records of the treatment of erysipelas by ultra-violet rays have been published by a few continental, and later, American writers, workers in this country have concentrated rather on attempts at specific therapy, and appear to have altogether neglected the investigation of this line of attack.

<sup>37)</sup>  
Koenig was one of the first to experiment with this mode of treatment, having employed it as early as 1913, using a quartz-mercury vapour lamp. While admitting its efficacy in certain cases, he pointed out that in others it failed to attain the desired object, and came to the conclusion that it could not be considered a certain cure.

<sup>38)</sup>  
Later, Petenyi treated 14 infants suffering from erysipelas with a quartz-mercury vapour lamp. Two of his cases, in which treatment was commenced at a late stage, died, but the remaining 12 recovered. In the latter cases, he records, after one irradiation there was hardly any further spread, and the condition cleared up entirely after two to three treatments. All his cases were under ten months, three of those

surviving being new-born infants with umbilical infection. Considering the usual death-rate of erysipelas in infants these results were remarkably good. He specified dosage simply in terms of time and distance from the lamp, his commencing dose being less than that necessary to produce an erythema.

39)  
Czepa in 1922 after referring to the good results reported by others in the treatment of erysipelas by this means, reported a series of 100 cases treated thus, and "in almost every case the temperature fell promptly after the first irradiation, and the spread of the inflammation ceased". Although his cases appear to have been uncontrolled, his results, he says, were so constant that they cannot be attributed to chance. He also used the quartz-mercury vapour lamp, but only states the time of exposure and the distance from the lamp, the first dose, in the case of a new burner being 10 minute at 80 cm., and with an old burner, 15 minutes at the same distance. This unfortunately leaves us in doubt as to the exact degree of reaction produced. He continued irradiation for two to three days after the temperature had subsided.

40)  
In 1924 Brunauer referring to the varying results obtained by previous workers, attributed this to the variable methods in which the treatment was applied. He himself recorded 15 cases treated by ultra-violet light, but his technique was different from that previously adopted. He covered the centre

part of the lesion, and irradiated only the spreading edge, along with a margin of healthy skin, on successive days. The small number of cases treated and the lack of adequate controls make it difficult to estimate the value of the treatment in his cases, but it may be noted that in 11 of the 15 cases there was a fall of temperature and disappearance of symptoms, after only two irradiations. Like previous workers he estimated dosage in terms of distance from the source of light and length of exposure.

41) Becker, in 1927, also using a mercury vapour lamp recorded two cases in which actinotherapy had immediately good results, and recommended exposure to one-and-one-half times the erythema dose of an area extending 4 cms. beyond the erysipelalous area in all directions. In his cases the erythema dose was accurately determined by means of a dosimeter. In both cases one such application was sufficient to cause a fall of temperature to normal, and disappearance of all symptoms. He stressed the fact that in cases reported by other workers, failures appeared to be due to inadequate exposure.

42) Two years later he called attention to the fact that the mortality in erysipelas is inversely proportional to the age of the patient, and reported that in eight infants ranging in age from 18 days to 12 months, with erysipelas treated by means of ultra-violet irradiation with one-and-one-half times the individual erythema dose, only one death occurred, and

that was in an infant aged 20 days, in whom erysipelas followed an operation for umbilical hernia. In most of his patients who recovered, the erysipelas was of the most malignant form. He also continued irradiation for a few days after apparent cure.

43)  
Ude of Minneapolis published in 1929 a spirited protest against a statement that there was no scientific justification for the use of ultra-violet radiation in the treatment of erysipelas, stating that in his hands the results of such treatment "have not been duplicated ..... by any other method of "therapy".

44)  
Later, in an interesting and instructive report, he compares the results obtained in treating a large number of cases of erysipelas by various methods: 91 cases were treated by ultra-violet radiation, 30 of them being complicated. Of the complicated cases, 4 died: the 61 uncomplicated cases recovered. His conclusions were that the various methods used (Roentgen radiation, ultra-violet radiation, anti-toxin, and combinations of these) "gave practically the same end-results, with some "minor advantage for the ultra-violet series". In his series of cases the quartz-mercury vapour lamp was used, placed at a distance of 8 inches; a dosimeter was not used, the exposure time being represented by "twice the time required to produce a "mild erythema on normal skin". This was found to be below the vesiculating dose. A margin of one inch of normal skin beyond the raised edge of the disease



was included in the exposure, and the treatment was not repeated unless there was definite extension. In a few cases the treatment was repeated two days later.

The results in the above series of cases were considered so satisfactory, that an extensive trial of the method was embarked upon, and in 1930, Ude and Platou<sup>45)</sup> published a valuable comparative study of various methods of treatment used in 402 cases, adequately controlled. The methods used included

- (1) magnesium sulphate and glycerine packs.
- (2) Roentgen irradiation.
- (3) ultra-violet irradiation (79 cases).
- (4) Roentgen and anti-toxin and
- (5) ultra-violet irradiation and anti-toxin.

They pay tribute to the excellence of the results in ultra-violet therapy, in the statement that "ultra-violet irradiation has none of the objectionable features of the other methods, while it seems to excel them in effectiveness". They found that in 92 per cent. of their cases clinical arrest of the dermatitis followed the first treatment by ultra-violet radiation. In this series the dose used was again twice that required to produce a mild erythema on normal skin, the actual time of exposure varying according to the decreasing efficiency of the lamp used. A study of the figures quoted shows that the average time from admission to return of normal symptoms was shorter in the group treated by ultra-violet radiation than in any of the others, the next



shortest being in the group treated by Roentgen irradiation. The control cases were treated with magnesium sulphate and glycerin packs only, other treatment being symptomatic. The most critical test to which various methods of therapy can be subjected is a comparison of their effect on the total duration of the disease, and in this connection the results obtained by Ude and Platov showed that the duration of the disease after treatment by ultra-violet irradiation was commenced averaged three and one-third days less than in the control cases. In the case of Roentgen irradiation the corresponding figure was two and one-third days.

46)

Brown reviewing the available literature in the treatment of erysipelas by ultra-violet light considers the efficacy of the method proven, and laments the fact that there is as yet no extensive series of cases reported by a British worker.

#### Series of Cases treated by Ultra-violet Irradiation.

In the series of cases to be described presently, the source of ultra-violet light was a standard model air-cooled "Hanovia" quartz-lamp, working on a direct current. The efficiency of the lamp was tested on a series of patients by exposing small areas of the skin of the forearm through a perforated armlet for varying periods, with the arc at a fixed distance of 12 inches from the skin surface. In practically all the cases, following an exposure of  $2\frac{1}{2}$ -3 minutes at this distance,

a mild but definite erythema resulted in 2-4 hours, and lasted a few hours. In a few of the cases treated, the individual "erythema dose" was reckoned thus before treatment was commenced, but as individual differences in response at such short range proved to be very slight, and as such a preliminary investigation entailed deferring actual treatment when the case was first seen in the evening,  $2\frac{1}{2}$ -3 minutes was assumed to be the universal erythema dose, except in the case of infants. For actual treatment one and one-half times to twice the erythema dose was employed, an exposure generally lasting 5 minutes. In all cases before estimating the erythema dose and before commencing treatment, the lamp was allowed to burn for at least 5 minutes to ensure as far as possible a constant output.

The first case treated was one of "wandering" erysipelas in a female aged 54 years. In this case the dermatitis had spread from the face and scalp over the shoulders, and pyrexia had lasted 9 days before light treatment was commenced. An injection of Scarlet Fever Antitoxin on the 5th day had had no effect. At first the whole of the spreading edge and a margin of 1 inch of healthy skin was irradiated, the exposure being insufficient to cause an erythema. This had no obvious effect on the spread of the dermatitis, even when repeated on successive days. An exposure sufficiently long to cause a definite erythema was attended with no better results. On

the 12th day of illness one half of the spreading edge was exposed to one and a half times the patient's "erythema dose", the other half, protected by bed linen, acting as a control. During the next 72 hours marked spread occurred on the untreated side, while the other showed, at a higher level, a definite band of erythema through which no spread occurred. In the course of another 24 hours - four days after irradiation - a spread in the form of isolated patches was evident ahead of the erythema on the treated side. The question then arose whether spread had occurred through the erythematous band, or laterally from the continued spread on the untreated side. The following day the previously treated side was exposed to twice the erythema dose, the exposure including 2 inches of the affected skin, and 2 inches of the healthy skin ahead. Again this appeared to arrest spread for about 48 hours, but as before, the improvement was only temporary. On two subsequent occasions the treated side was exposed for a further 5 minutes at 12" with the same result - a temporary arrest of spread lasting 48-60 hours, while the untreated side spread continuously. This case, although the method of control adopted was necessarily imperfect, appeared to hold out a promise of good results from actinotherapy if the whole of the spreading edge could be adequately tackled.

In the 51 cases subsequently treated thus, this was carried out as far as practicable, but as the treatment was not restricted to early or mild cases,

in a few instances only part of the spreading edge was available. In some of these for example, the lesion had already spread from the face into the scalp before admission to hospital, and spread was evident both there and on the face. In such a case, exposure of the margin on the face frequently appeared to arrest spread there, although the continued spread in the scalp rendered it impossible to assess any amelioration of symptoms which might have accrued. Again, in the case of erysipelas of the perineum in a puerperal woman, irradiation of the entire margin was impossible, and treatment had to be deferred until the lesion had spread to parts more accessible. A further source of error in such a case was the difficulty of securing a uniform exposure of the whole edge. Obviously when a limb was involved it was inevitable with the arc at a distance of only 12 inches that part of the skin surface under treatment should be exposed to rays striking it at right angles, while the angle of incidence of the rays in other parts was acute. In short range work this is an important item in estimating the dosage to be employed and the effect to be expected. Apart from the efficiency of the lamp used, its distance from the patient's skin, and the duration of the exposure, the effect varies according to the angle of incidence, rays falling perpendicularly on the skin having a more intensive effect than those falling at an acute angle, just as the illumination from a beam of light

varies. Rays with an acute angle of incidence are for the most part reflected from the skin surface, and do not penetrate.

With regard to distance from the lamp, the effect of the active rays is inversely proportional to the square of the distance.

Technique - In the treatment of cases the lamp was placed alongside the part to be irradiated, and at a higher level to avoid the possibility of a burn resulting from a broken tube. Any soothing preparation previously applied to the part, especially if greasy, was carefully removed from the inflamed area and surrounding skin before treatment was commenced. All cases except infants, were exposed for 5 minutes with the lamp at a distance of 12 inches, in order to get as large a concentration of the short wave-lengths as possible. While normally a child may be exposed to ultra-violet light for the same length of time as an adult, in the intensive short-range technique employed, this was considered inadvisable, because of the relatively greater area of skin treated, and an exposure was made of one and one-half times the assumed erythema dose. In all cases part or all of the inflamed area, according to its extent, was included in the exposure, with a margin of about 2 inches of healthy skin where this was possible, the rest being protected by some light covering. In this connection it is necessary to note that under ultra-violet light the skin for a short distance ahead of the visible and



palpable edge is frequently seen to be already affected. In facial, and head cases generally, the eyeballs were protected with small pads of cotton-wool fixed by a narrow strip of adhesive plaster, but the eyebrows were left exposed, and each part was systematically exposed to rays falling as far as possible perpendicularly. When the entire involved area was easily covered by one exposure, this completed the treatment, but occasionally part of the lesion which at the time of admission was assumed to have subsided, was neglected, and had to be treated later. In the few cases where definite extension through the erythematous area occurred the treatment was repeated one or two days later, if a margin of healthy skin could still be included. In a few cases where intensive treatment was limited to a very small area, this was followed up by exposure of the trunk to a brief, non-erythema producing dose for 2 or 3 consecutive days. Following treatment the affected part was left uncovered, or at least without dressings: in two instances where pain was a prominent feature lint wrung out of cold water and frequently renewed was applied. All other treatment was symptomatic.

Cases treated - The cases treated numbered 51, ranging in age from 7 months to 74 years, and included "primary" cases and cases secondary to accidental wounds, operations, and confinements. As usual there was a marked preponderance of facial cases.

"Subacute" cases, showing no pyrexia or other constitutional disturbance, were not treated, and are not included in the series. One case was moribund on admission. Table I shows the age and sex incidence in the cases treated.

Table I - Age and Sex Incidence.

Sex	Age period in years										Totals
	0-1	1-4	5-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	
Male	1	0	0	1	1	5	1	7	3	1	20
Female	0	2	1	5	7	2	4	8	2	0	31
Totals	1	2	1	6	8	7	5	15	5	1	51

The duration of illness before admission to hospital varied from one to eight days, the average for the series being four days.

#### Results of Treatment - Immediate:-

During the exposure the patient in no instance complained of discomfort. On the contrary the sensation of warmth produced appeared to be appreciated. In the course of a few hours, the healthy skin included in the radiation area showed an intense erythema, with a degree of oedema, the appearance being so similar to that of the erysipelatous area as to render the edge of the latter at times indistinguishable. Existing oedema of the actual lesion was slightly increased. At this stage, as a rule, there was no complaint of pain, even when, as occasionally happened, there was a crop of tiny vesicles on the affected area, on an oozing of serum. Local application were unnecessary, as even in these cases where the bloated appearance of the face suggested extreme discomfort there was little or no complaint, and patients were repeatedly seen reading or writing when the whole face and eyes were markedly oedematous and even crusted with dried serum. By the end of 48 hours the oedema had generally subsided and the affected skin became dry and wrinkled. By this time also there was a critical fall in temperature in 31 of the 39 cases in which the whole edge of the lesion was tackled. In 23 of these cases the fall commenced within 24 hours. The further course of cases was for

the most part uneventful, the sole complication seen being streptococcal abscess which occurred in 2 of the 47 cases surviving the initial erysipelas. In one of these cases, the patient, a female, at the time of admission had an earring buried in a markedly oedematous ear. The other case was one of erysipelas of the thigh, the dermatitis commencing at a point from which Thiersch skin grafts had been removed for a healing mastoidectomy. In this case a superficial abscess developed on the inner aspect of the thigh.

With the dosage adopted, twice the "normal" erythema dose for the lamp used, vesiculation following irradiation seldom occurred, and when it did, appeared to cause no real discomfort, or to prolong the course of the illness. In only one case was a severe degree of vesiculation produced, the patient being a case of puerperal septicaemia and pneumonia, profoundly anaemic, who had contracted erysipelas of the face. In this case vesiculation without obvious erythema followed irradiation, and the patient died. In such a case of course, moribund on admission, treatment of any sort would have been useless.

#### Ultimate Effects of Treatment.

To gain a true conception of the value or otherwise of radiation therapy, it was essential that the cases treated should be adequately controlled. This was done by selecting as a control for each case treated, a similar case treated by other means. In allocating "controls", the hospital records for the

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past five years were searched, special attention being paid to a consideration of age, sex, localisation and extent of lesion, duration of illness, and complications present. In all cases it was found possible to allocate a suitable control. In assessing the therapeutic value of phototherapy employed thus, attention was paid to

- (a) the duration of the pyrexia.
- (b) the extent of spread of the inflammatory lesion.
- (c) the incidence of complications and
- (d) the occurrence of relapses.

The mortality rate in such a short series of cases is valueless, but a description of the cases which died is interesting.

Of 51 cases treated, 4 died. The first death occurred in the case of an infant aged 13 months, admitted on the 5th day of illness, in whom the lesion had commenced on the cheek. On the 2nd day of illness a mastoidectomy had been performed, the erysipelalous condition being ignored, and at the time of admission the child was gravely ill, with a badly infected wound. In this case exposure to actinic rays appeared to arrest the erysipelalous condition, but the child died 3 days after spread had ceased.

The second death occurred in the case of a female, aged 30 years, admitted on the first day of illness, the erysipelas being a complication of pneumonia and nephritis. Here also the dermatitis



cleared up after treatment, three days before death.

The third case was a puerperal woman whose blood at the time of admission yielded a culture of haemolytic streptococci, and who in addition suffered from pneumonia and facial erysipelas.

One death may be directly attributed to the disease, but the patient, a female aged 55 years, was already under treatment for severe cardiac decompensation when admitted to the ward, and died suddenly on the 5th day of illness.

In 47 cases treated and ending in recovery were of varying degrees of severity, and in estimating the effect of treatment the temperature chart was taken as the safest single guide, the disease being presumed to have ceased on the day on which the morning or evening temperature was first subnormal and did not subsequently rise except when due to an obvious complication. In some of the cases only one section of the lesion was irradiated: in others a margin of skin all round the inflamed area was included in the exposure, and in the remainder the whole lesion and surrounding healthy skin were treated.

The results of treatment are briefly summarised in Table II.

Series.	covery.		
	Duration of illness before admission, in days.	Average duration of fever, in days.	Average duration of fever after treatment.
47 Cases treated by u.v. rays.	3.96	7.81	3.85
47 Control cases	4.10	9.26	5.16

In the 39 cases in which it was found possible to tackle the whole extent of the spreading edge, the results were as follows:

39 Cases treated by u.v. rays.	3.72	6.97	3.25
39 Control cases	3.91	9.03	5.12

In 10 cases in which the whole affected area and a surrounding margin of healthy skin were irradiated, the results were even better:

10 Cases treated by u.v. rays	3.40	5.50	2.10
10 Control cases	3.31	7.92	4.61

Similarly of 8 cases in the series in which treatment was commenced early in the disease - on the second day of illness - the average duration of fever was again 5.5 days as against 9.6 days in the corresponding control cases.

### Extent of Spread.

Definite spread of the dermatitis through the irradiated area of healthy skin occurred in a few cases - especially in those cases in which treatment was commenced at a comparatively late stage, and the lesion was obviously very active i.e. where the natural resistance was defective. This was noticed particularly in cases of the "wandering" type, where 2 or more exposures of the spreading edge at intervals of 2 days were necessary before spread was arrested.

### Incidence of Complications.

As noticed above the sole complication seen was streptococcal abscess which occurred in 2 cases.

### Incidence of Relapses.

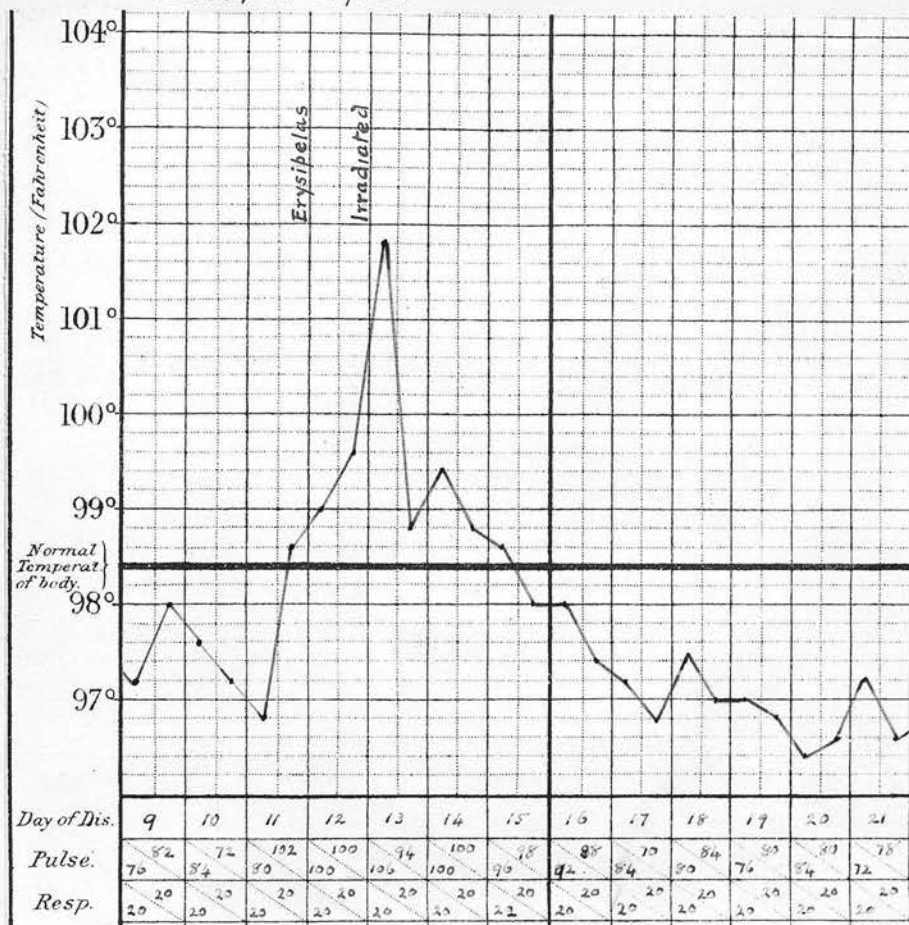
Relapse occurred in two of the 47 cases treated and surviving: in one of these the inflamed area was promptly re-irradiated, and the condition subsided completely within 24 hours of the onset.

In another case, not included in the series, in which the initial attack in spite of serum therapy, lasted 17 days, there were four relapses. The first occurred 13 days after the temperature had reached normal, and the temperature rose again, remaining elevated for six days. Eleven days later another relapse occurred, and it was decided to try actino-therapy: on this occasion the patient ran a mild temperature for only 48 hours. Ten days later she again relapsed and was promptly radiated, this time

without any recorded rise of temperature. After a further ten days a final relapse took place, and under actinotherapy the temperature was again normal within three days.

Temperature charts are misleading especially in erysipelas, and it is not proposed to reproduce a series in this paper. One example however of a case treated early is interesting, and the chart is reproduced below. The patient was in hospital at the time of onset of the disease, convalescing after diphtheria. The erysipelas commenced on the 11th day of illness, and on the morning of the 12th day involved both cheeks, orbital regions, and glabella. There was considerable oedema, with numerous small vesicles on the affected area, and a rapidly advancing well marked edge all round the lesion. The patient a female aged 34 years, was markedly ill, noisy, and confused. The parts were subjected to three exposures of ultra-violet light at one sitting - one to each cheek and one to the glabellar region - on the afternoon of the 2nd day, with gratifying results: no further spread occurred, the common feature in such cases of oedema of the external auricle failed to appear, the mental condition improved forthwith, and the temperature immediately commenced to recede.

Female, aet 34 years.



It is worthy of note that although no spread of the local lesion was detectable after radiation, the temperature did not become permanently subnormal until 48 hours later, so that the temperature alone is not a true indicator of the continued activity or otherwise of the lesion. This explains also why the "average duration of pyrexia" in cases treated by radiation was seldom less than 5 days, even in early cases in which there appeared to be a prompt response to phototherapy as far as cessation of spread was concerned. In such cases however the amelioration of other symptoms and the increase in the patient's comfort were gratifying features.



From these results it would appear that, if acute cases of erysipelas came under treatment sufficiently early - preferably during the first 48 hours of illness - , prompt exposure of the affected part to what is customarily considered an overdose of ultra-violet rays, would in a large proportion of cases, abort the lesion. The method also has the advantages of being easily applied, inexpensive, and of affecting a considerable saving of dressings and linen as no local applications following treatment are necessary, or indeed desirable. Carefully applied, the method is devoid of danger, and even of unpleasant sequelae, while the usual complications of erysipelas, at least in cases which are treated early, appear to be less frequent. A dosimeter is unnecessary: if the operator takes the trouble to estimate at regular intervals the "efficiency" of the lamp used, the "erythema dose" for the individual patient is easily and quickly ascertained; and even when the individual erythema dose is not investigated - and such a test is unnecessary - but is gauged from previous experience with the lamp in use, there is a wide margin of safety.

## SUMMARY AND CONCLUSIONS.

1. A brief account is presented of past and present therapeutic methods in the treatment of erysipelas, with a record of 51 acute cases treated by exposure to an artificial source of ultra-violet light, the exposure being one and one-half times to twice that required to produce a definite erythema on normal skin.

2. The treatment of erysipelas, particularly the early case, by ultra-violet light appears to yield results comparable to those of any other method, and to be worthy of further trial.

3. The method is universally applicable, readily available, devoid of danger, cleanly and inexpensive.

4. The technique is simple and can be carried out with any ultra-violet lamp of known efficiency.

The cases detailed are from the records of the Edinburgh City Hospital.

The opportunity for and inception of this work are due to Dr. W.T. Benson, Superintendent of that institution, to whom the writer is deeply indebted.

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