

THE
THERAPEUTIC VALUE
OF THE
QUARTZ MERCURY VAPOUR LAMP
IN THE TREATMENT OF
ACUTE SCARLET FEVER AND SERUM URTICARIA

Thesis submitted for the

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by

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Introduction.

An epidemic disease, resembling scarlet fever was first described by Ingrassias about the middle of the 16th Century. To the people of his time this disease was known as rossania or rossalia. Danuel Sennert at the beginning of the following century described an outbreak in Wittenberg and was the first writer to mention scarlatinal desquamation and arthritis. Sydenham in 1675 noted the mildness of scarlet fever and distinguished the disease from measles. The description of the disease and its complications was followed by suggested palliative measures. Numerous methods of treatment have been indicated and tried and much, no doubt, has been discarded, but each has added something to our knowledge of the subject, however incomplete that may be. Even with the advent of Streptococcus Antitoxin (Scarlatina) it cannot be said that a specific has been found.

The whole subject of treatment is of importance. Apart from the view of doctor and patient, scarlet fever is the main contributor to the work of fever hospitals, and the average period of detention of each patient in hospital is still about five weeks. The case, presenting septic sores, rhinitis, and otorrhoea, which necessitates a stay in hospital of fifteen weeks or more is still seen,

so that any new method of treatment which has in view the shortening of the patient's stay in hospital and the relieving of his symptoms is worthy of trial.

With these ideas in view the writer turned to a method of treatment as yet practically unexplored in relation to scarlet fever, namely, treatment by general irradiations from a Jesionek Quartz Mercury Vapour Lamp.

Exposure of the body for the healing effect of light is by no means new. From the beginning of time the sun has been worshipped as the source of life and light; a healing agent fit to overcome dread darkness with its associated death and destruction.

The Persians worshipped the sun god Mithra; the Egyptians believed in Ra, while the Arabians, Romans and Greeks were as convinced of the health giving efficacy of the sun's rays as is the youth of to-day.

In the temple erected to Aesculapius, Hippocrates about 460 - 370 B.C. practised heliotherapy. Herodotus (431 B.C.) and later Celsus and Galen (A.D. 130 - 200) also considered sun treatment.

In Peru the Incas treated syphilis by heliotherapy.

Notwithstanding the proof of the beneficial results following heliotherapy the advent of Christianity abolished

pagan practices and it was not until the end of the eighteenth century after the passage of the Dark Ages that light treatment regained prominence.

In 1774 Faure employed the sun's rays in the treatment of ulcers.

In 1815 Leobel noted the benefits of insolation in various conditions.

In 1845 Bonnet advised local and general applications of light in the treatment of tuberculous osteoarthritis.

Finsen proved the usefulness of ultra-violet light as a therapeutic agent in the treatment of lupus.

In 1903 Rollier obtained outstanding results in the treatment of surgical tuberculosis in the brilliant sunshine of the Alps.

In 1908 Nagelschmidt designed the air-cooled quartz mercury vapour lamp such as was used by the writer in the following investigation.

Infectious diseases have not been overlooked by those studying the effects of ultra-violet light but the literature, in this sphere, is somewhat scanty.

Russell (20) points out that ultra-violet radiation is particularly useful in the treatment of infectious fevers. Another authority (1) states that

generally speaking actinic rays are contra-indicated during the acute febrile stage but that later on the immunising forces of the body may be stimulated to greater activity by irradiation.

Turner (25), in treating whooping cough, notes cure in an average of twenty days, freedom from complications, and improved general condition. Scholten and Rohr (21) confirm this. Barenberg, Freidman and Green (4) point out that ultra-violet light radiations have no effect in the prophylaxis of pertussis.

McKenzie and King (18), in treating chickenpox, recommend irradiations every other day once the temperature is normal. Sack (2) noted the preponderance of the eruption on skin already irradiated but Reiche and Bach (2) failed to confirm this.

Löwenstein (2) has shown that diphtheria toxin is easily destroyed by quartz light rays. There is, however, a considerable doubt as to whether diphtheria is a suitable field for treatment by ultra-violet light.

The beneficial effects of local treatment of the throat in cases of diphtheria carriers seems to be undoubted. Luzes (16) reports that all his cases were cured after a few sessions; and the results obtained

were verified by repeated swabs. Donnelly (11) and Lingenfelter (15) strongly support him.

Many writers are agreed on the beneficial results in the treatment of erysipelas. Davidson (9), after treating fifty one cases by exposure to an air-cooled mercury vapour lamp, concludes that "the treatment of" "erysipelas, particularly the early case, by ultra-" "violet light appeared to give better results than" "any other method in use." Russell (20) states that if the application is given sufficiently early in the course of the disease only one is required. Becker (5), Bohmer (6), Bach (3), and Troup (24) are among those who mention the good results obtained in this disease.

References to treatment of scarlet fever by ultra-violet light are few. Russell (20) mentions the bare fact that cases have been treated. Dawson (10) comments on the good results obtained in debilitated convalescent scarlet fever patients by treatment with the Jesionek Mercury Vapour Lamp.

The introduction of antiscarlatinal serum has undoubtedly been of benefit in the treatment of scarlet fever but an unfortunate sequel to its administration is urticaria. In the West Fife Infectious Diseases Hospital, Dunfermline, serum is given as a routine

measure and the writer has had ample opportunity of noting the distress of patients developing serum urticaria. Further, he has been impressed by the apparent futility of giving adrenalin to such cases and therefore was led to try the effects of ultra-violet light on the patient and on the serum before administration.

The following is a record of the writer's results in determining the value of ultra-violet light in the treatment of (a) acute scarlet fever and (b) urticaria produced by the administration of Streptococcus Antitoxin (Scarlatina).

Apparatus and Technique.

The apparatus and technique employed in irradiating the cases of scarlet fever and of serum urticaria are considered.

Ultra-violet rays are produced by the passage of an electric current between terminals of special material, the arc formed giving out an intensive illumination consisting of ultra-violet "cold" and visible rays.

Any heat generated as part of the incandescence in quartz lamps is absorbed by the arc tube and re-radiated.

There are two main types of arc.

(1) Enclosed.- Mercury Vapour in Quartz Tube.

(a) Air Cooled.

(b) Water Cooled.

(2) Open.- Solid electrodes.

(a) Carbon (plain or cored).

(b) Iron (rarely used).

(c) Tungsten.

1. (a) Air Cooled.

The type of lamp used in this investigation was a Jesionek Quartz Lamp of four Amperes and 250 volts containing a powerful quartz burner housed in a large

box shaped reflector. This lamp is suitable for the general irradiations such as are desired in treating cases to be considered.

The problem of dosage was solved by trial and result. As a working standard the Second Degree Erythema dose was chosen. This is defined as a mild reaction as of slight sunburn with definite reddening and slight exfoliation. The sensitiveness of scarlet fever convalescents was judged by covering the forearm with a piece of cardboard in which there were several holes which could be covered after exposure. The first hole was exposed at the required distance thirty inches for one minute, the second for two and so on up to five minutes. The following day the degree of erythema was noted and the thereapeutic exposure given accordingly. Dosage was standardized by this method at intervals of about six weeks.

At this juncture it is worthy of note that the air cooled quartz lamp for general treatment has of recent years been greatly improved. In the new Alpine Sun Lamp the quartz mercury arc burner is of new design. The reflector also has been entirely re-designed. At a distance of forty inches a first degree erythema on normal untanned skin may be induced after ninety seconds exposure.

The high intensity of the new lamp is maintained practically uniform throughout its operating life of a thousand hours so that the dosage factors (time, distance, etc.) can be kept constant. This is achieved by the application of an entirely new technical development which is governed through the time-graduated Rheostat-control.

The dose was varied slightly in some cases according to individual requirements. Persons of dark complexion and those who tan on exposure to the sun were given larger doses than fair people with blonde or reddish hair or those who blister easily. The cases were irradiated singly recumbent upon a ward trolley in a room temperature of about 70°F. The patient was well wrapped in blankets and transported from the ward to the irradiating room on the trolley on which he was irradiated. Convalescent patients were irradiated in groups of three or four.

Only cases of undoubted scarlet fever were chosen for irradiation. They presented bright rashes with the usual accompanying high temperature and sore throat. These cases were divided into two groups. The smaller group received irradiations on admission to hospital; as will be seen later, however, it was thought advisable to discontinue this practice. In the larger group the

temperature was allowed to reach normal limits before the patient was exposed to the rays of the lamp.

The following table shows a typical course of irradiations starting early in the disease.

Day of Disease.	Time.	Distance.	Area Irradiated.
On admission to Hospital.	4 minutes	30 inches	Back and Front) 2 minutes each
2nd day	do.	do.	Back and Front) 2 minutes each
3rd day	do.	do.	Back and Front) 2 minutes each
7th day	do.	do.	Front
11th day	do.	do.	Back
15th day	do.	do.	Front
19th day	do.	do.	Back
23rd day	5 minutes	do.	Back and Front) 5 minutes each
28th day	do.	do.	Back and Front) 5 minutes each
33rd day	do.	do.	Back and Front) 5 minutes each

The Mercury Vapour Lamp, as will be shown, has amply justified its use in the treatment of anti-scarlatinal serum urticaria. A rapid dose to the skin surface involved by a "handy" type of lamp is possible. Irradiation may take place in bed as the

condition appears about the tenth day of the disease when removal of the patient may be undesirable.

1. (b) Water Cooled. Super Kromayer.

This type of lamp is intended for intense local use and orificial treatment. By means of compression lenses and quartz applicators the rays can be conveyed on a relatively small area. While this type of lamp would be ideal for treating otorrhoea, rhinitis, and septic sores so often met as complications of scarlet fever, it is hardly in accordance with the purpose of this paper.

2. (a) The 'Flaming Arc' Lamp is well suited for hospital work since several patients can be irradiated at the same time. The arc takes its name from the length of the flame, the gap being capable of extension to four and a half inches by increasing the voltage; the ultra-violet output is correspondingly increased.

Electrodes consist usually of carbon which may, with the object of enhancing the output, be cored with tungsten, iron, or some other metal.

This arc produces intense radiations in the near region its spectrum extending from 7,700 A to 2,800 A.

The writer has no experience of the carbon arc lamp in the treatment of scarlet fever, but considers that it would be most suitable for irradiating patients able to be out of bed in the later stages of the disease. The patient would be able comfortably to withstand the longer exposure required and would be benefited by the general effect.

2. (c) Tungsten Arc.

The spectrum extends to about 1,850 A. with few absorption bands. Since the cost of tungsten is prohibitive carbon electrodes treated with this metal are usually used. This type of lamp evokes delayed erythema.

Contra-Indications.

The contra-indications to the use of the mercury vapour lamp seem to be few. Most observers, including Humphris (14), Russell (20) and Bach (2), acknowledge the risk in cases of myocarditis. No case giving a previous history of rheumatism or showing signs of a cardiac lesion was exposed to the rays.

Pulmonary tuberculosis, where a febrile condition exists, is stated to be a contra-indication. The cases irradiated showed no evidence of pulmonary involvement.

Opinions differ in relation to nephritis. C.E. Serier (22) has shown that treatment by ultra-violet light is contra-indicated if nephritis exists, while Plank (19) holds opposite views. The writer examined the urine of cases before irradiation and did not consider a trace of albumen in the urine of a febrile case a contra-indication.

EFFECTS OF IRRADIATION.

For the purpose of investigating the effects of irradiation on the rash, skin and desquamation, and temperature, fifty cases of typical scarlet fever in the acute phase of the disease were taken. These were compared with fifty cases receiving antiscarlatinal serum and fifty cases receiving no specific treatment.

The effects of irradiation as observed in these cases are given as follows:-

(a) Effects on Rash.

As a result of a careful study of the cases I found that both in the untreated cases and in the cases treated by ultra-violet light the rash remained on an average till the end of the fourth day. In the series of cases receiving 10 c.cs. of anti-scarlatinal serum intramuscularly the duration of the rash was two days.

I was unable to find that ultra-violet light had any effect on the duration of the rash.

I observed with interest that, when viewed under the mercury vapour lamp, the punctate element of the rash was accentuated, the spots assuming a bluish tint. The apparent disappearance of the

flushed background made their periphery more clearly defined. It was further noted that when a rash had apparently disappeared its punctate character became evident again under the influence of ultra-violet light.

The writer is convinced that the mercury vapour lamp can be of great value in the diagnosis of scarlet fever rashes in doubtful cases.

(b) Effect on Skin and Desquamation.

1. Penetration.- That ultra-violet radiations are transmitted through epidermis 0.1 mm. and 1 mm. thick is shown by Hasselbalch in the following table; the figures are given as percentages of the incident radiation.

Wave-length	4360	4050	3660	3540	3130	3020	2970	2890
0.1 mm.	59	55	49	42	30	8	2	0.01
1 mm.	0.5	0.3	0.08	0.02	-	-	-	-

2. Skin Functions.- The skin is more than a protective covering. To a large extent it controls the heat regulation of the body and plays a part in vitamin elaboration. Within it are the receptors of the blood lymphatics and nervous systems. It is

probable that, when this cellular structure is subjected to radiant energy as in ultra-violet irradiations, electro-chemical reactions take place and the products of these pass into the general circulation to exert an effect on structures removed from the skin.

3. Erythema.- In from one to eight hours after an effective irradiation the stage of engorgement or erythema is reached. Its time of appearance, intensity, and duration depend on the extent of the disintegrative changes and on the sensitivity of the individual.

In the stratum mucosum the cells are separated by lymph. In the stratum germinativum grouping of pigment granules round the actively dividing cells takes place.

The greatly dilated capillaries become the site of circulatory stagnation; active diapedesis takes place from the non-thrombosed vessels and there is considerable oedema while phagocytes remove thrombi from the superficial vessels. As the exudation increases the cuticle becomes separated from the stratum granulosum.

Two or three days later the eleidin granules and the nuclei of the prickle cells have disappeared entirely. The cuticle shows thickening and later

desquamation occurs. When the various processes have subsided the skin recovers its former appearance.

The above changes demonstrate phases in the process of cell damage and cell replacement, the latter being effected by each stratum replacing the one above it. The stratum granulosum replaces the cuticle, the mucosum the granulosum and the germinativum the mucosum, these changes developing simultaneously. The engorgement of the capillaries accelerates the process of tissue repair besides exercising decongestive effects on the underlying structures.

Russell (20) mentions the fact that desquamation was expedited in scarlet fever cases treated with ultra-violet light. The writer, in considering his own cases disagrees with this view. Broadly speaking he found that the process of desquamation differed little in cases receiving no special treatment from those treated with ultra-violet irradiations. If anything, the process of desquamation was prolonged.

(c) Effect on Temperature.

In none of the cases observed was there a rise of temperature immediately after irradiation. This

was one of the factors which encouraged the writer to pursue the investigation when he started in an experimental way with acute cases.

The fall of temperature of the irradiated cases corresponded closely with that of the cases which received no specific treatment.

It was seen that the temperature of both irradiated and untreated cases was normal seventy two hours after admission. This is in marked contrast to the serum treated cases in which the temperature fell almost by crisis to regain normal limits thirty six hours after admission.

It has not been found that irradiation has any direct effect on the temperature.

(d) Effect on the incidence of Complications.

The following table gives the percentage of complications occurring in the different groups treated. The one hundred and eighty seven cases in each group were studied concurrently thus allowing, as far as possible, for any variation that might take place in the severity of the type of the disease over the period of observation. The one hundred and eighty seven cases treated by ultra-

violet light include those in which treatment was commenced on admission (fifty cases), and those in which the temperature was allowed to settle before exposure to the lamp.

Complications.	Serum treated cases.	Cases receiving no specific treatment.	Ultra-violet light treated cases.
Septic Sores	7.5%	8%	1.6%
Otorrhoea	6.9%	7.5%	4.8%
Rhinitis	11.2%	10.2%	8.0%
Arthritis	4.3%	4.8%	4.8%
Adenitis	11.2%	11.2%	11.2%
Nephritis	3.7%	5.3%	8.0%

Outstanding in the above table is the reduction of superficial septic sores in the cases exposed to ultra-violet light; this amounted to 5.9 per cent. over the serum treated cases and 6.4 per cent. over the cases receiving no specific treatment. This is in consonance with Browning and Russ (7) who showed that there were two distinct regions of ultra-violet radiation. In the first region the rays have no germicidal action but can penetrate the skin, while in the second region the

rays have a powerful superficial germicidal action but little penetrative power. The relative freedom of the black tribes from acne and boils has been remarked upon, and Russell (20) notes that a similar immunity to skin infections can be produced by ultra-violet radiation, while Humphris (14) states that if an infected wound is exposed to ultra-violet light the surface pathogens are killed.

In addition to this direct lethal effect of the rays upon skin bacteria the writer considers that the resistance of the dermis to organismal invasion may be indirectly promoted by the stimulation of leucocytosis and increase of the bactericidal power of the blood. This view is supported by the observation of Strahlmann (23) that the inflammatory reaction of the tissues, evoked by insolation, led to vascular engorgement with increased diapedesis of leucocytes. Guavain and Sampson (14) noted a leucocytosis following irradiation, an observation corroborated by Russell (20). Hill (13) pointed out that the haemobactericidal power was increased by exposure to ultra-violet light: this result has been confirmed by Eidinow (12). It has been shown (8), however, that the haemobacterial power does not increase in man unless, as was done in the cases

referred to in the preceding table, an erythema is produced.

Otorrhoea and Rhinitis. In the cases irradiated these complications also show a definitely lessened incidence; on comparison with that of the untreated cases the reduction is one of 2.70 per cent. and 2.20 per cent. respectively, while on comparing the frequency with that manifest in the serum-treated cases the reduction is found, in respect of otorrhoea to be one of 2.10 per cent. and of rhinitis to be one of 3.20 per cent. This result is in accordance with the observed effect of ultra-violet light upon septic sores since both otorrhoea and rhinitis may be looked upon as septic catarrhal processes.

The occurrence of arthritis shows little variation in each of the series of cases. If ultra-violet light has any effect in the prevention of arthritis it will be indirect as already noted by Strahlmann (23), Hill (13), and Eidinow (12).

In the frequency and occurrence of adenitis among the cases treated by ultra-violet light, no marked difference from those treated by other methods was noted. That ultra-violet light may have some

effect on glandular conditions was noted by Jesionek (2); this worker pointed out that the powerful hyperaemia and leucocytic migration are by no means confined to the surface immediately irradiated but extend deeply into the tissues, while Finsen (14), in 1891, showed that the blood in the capillaries absorbs actinic rays and that these rays have their effect in the glandular tissues, the phagocytic power of which is increased.

At first sight there is apparently a marked increase in the incidence of nephritis in the cases treated by ultra-violet light; showing an increase of 4.3 per cent. over the serum treated cases and 2.70 per cent. over the cases receiving no specific treatment. The 8 per cent. represents fifteen cases out of one hundred and eighty seven, and of these no fewer than six (3.20 per cent.) occurred in the fifty cases irradiated in the acute stage of the disease and before the initial temperature had settled. It is possible that chill, consequent upon removal of the patient from bed to the irradiating room, played a part in the production of this complication in these cases. Discounting the cases irradiated in the acute stage of the disease there is little difference in the incidence

of nephritis in the ultra-violet light treated cases as compared with the serum treated cases and those receiving no specific treatment.

(e) General Effect.

The writer found difficulty in assessing the general effect of ultra-violet radiations on the cases treated. The impression gained from clinical observation was that the "well being" of the patient was improved. The patient slept better and later his appetite appeared to be stimulated.

(f) Effect on Duration of the Disease.

In comparing the group of cases receiving no specific treatment with those receiving anti-scarlatinal serum and with those receiving ultra-violet light, the writer found no difference in the average number of days stay in hospital. It cannot, therefore, be claimed that ultra-violet light treatment has any effect in reducing the duration of the disease.

(g) Effect on a case of Erythema Nodosum complicating
Scarlet Fever.

Erythema Nodosum is a comparative rarity in scarlet fever cases, and, as there is no record in the literature

of a case treated with ultra-violet light, the following warrants mention.

A girl, A.B. aged 7 years, was admitted suffering from scarlet fever and received no serum treatment. On the twelfth day after admission she complained of 'sore legs'. The temperature was 103°F. The extensor aspects of the legs presented a series of red, raised, roundish swellings firm and definitely tender to palpation. The condition was undoubtedly one of erythema nodosum.

The extensor aspect of the legs was irradiated for five minutes at a distance of twenty inches with the Jesionek mercury vapour lamp.

Next day the nodules were slightly less red and tender. A second irradiation was given for six minutes at twenty inches.

On the following day the nodules were just visible and not palpable. After a further twenty four hours the temperature became normal.

Two observations by Sir Norman Walker (26) are of note. He states that "the first eruption is rarely the last; repeated crops make their appearance and prolong the duration of the disease from three to six

or more weeks" and secondly he states that "no local treatment has any curative effect." The only other case of this nature which I have observed occurring as a complication of scarlet fever was treated by anti-rheumatic measures and lasted for three weeks. From the relatively rapid cure in the case of A.B. it appears that ultra-violet light irradiations may prove a useful remedy.

SERUM URTICARIA.

Ultra-violet light has now been used for a considerable time in the treatment of urticaria. Humphris (14) points out that in chronic urticaria, mild applications of ultra-violet rays usually relieve the intense itching and clear up the condition. When the area of skin involved is extensive he advocates irradiation by means of the air-cooled mercury vapour lamp.

In discussing chronic urticaria, Russell (20) states that a second degree erythema dose with the air-cooled lamp applied generally gave the best results. He reports relief of itching and advocates the oral administration of calcium lactate as an adjuvant to treatment by irradiation. Further, E.C. Mundie (17) states that he "tried ultra-violet rays for a species of paroxysmal urticaria, nervous in origin, from which I myself have suffered, with immediate relief".

It will be noted that the above authorities refer to the chronic form of urticaria. A fairly wide review of the literature has yielded no single reference to the use of ultra-violet light in the treatment of serum urticaria, and the writer has been

prompted to explore the possibilities of ultra-violet irradiations in the treatment and prophylaxis of this acute condition.

Serum is now used in a great number of conditions, but, even in those where its beneficial results are undoubted, one serious drawback to its use is the occurrence of urticaria. In fever hospitals, anti-diphtheritic and anti-scarlatinal sera are most often employed. Both sera produce urticaria but in differing degrees. In this connection, and based on 100 consecutive cases which received 10 c.cs. of anti-scarlatinal serum and 100 consecutive cases which received an average dose of 11.75 c.cs. of anti-diphtheritic serum, the following observations, made by the writer, are of considerable interest.

In both groups of cases the age span lay between two and fifteen years; both types of sera were of equine origin and supplied by the same firm.

Notwithstanding the fact that those who received anti-diphtheritic serum were receiving a larger dose, and, despite the further fact that in 21 per cent. of them part of the serum was given intra-venously - the route capable of producing the worst type of urticaria, only 18 per cent. subsequently developed urticaria, whereas 29 per cent. of those who received anti-scarlatinal

serum (intramuscular only) developed the disease.

The incidence of urticaria in those receiving anti-scarlatinal serum was not invariable but varied with the batch of serum; one particular supply produced the condition in as many as 43 per cent. of cases treated with it.

It is evident, since 11 per cent. more of the cases which received it developed urticaria, that anti-scarlatinal serum is a more potent cause of urticaria than anti-diphtheritic serum.

The writer also noted that the urticaria produced by the administration of anti-diphtheritic serum was much more transient and less irritable than that produced by anti-scarlatinal serum. For these reasons cases of urticaria produced by anti-scarlatinal serum have been chosen by the writer for his present purpose.

Control Cases.

The following table shows the results of observations carried out on one hundred cases of urticaria produced by anti-scarlatinal serum and, with the exception of the last twenty cases which received adrenalin, entirely untreated.

These cases presented the typical appearance of elevated wheals with a marked degree of reddening. The whole body was involved.

TABLE I.

Day of appearance of urticaria after administration of serum.	Temperature at onset of urticaria.	Duration of urticaria.	Remarks.
8th	98.8°F	60 hours	Itching.
8th	N.	60 "	
9th	N.	48 "	
10th	N.	48 "	
8th	99.8°F	36 "	
5th	N.	24 "	
8th	N.	60 "	Itching.
16th	N.	48 "	
8th	N.	60 "	
8th	N.	120 "	
4th	100.2°F	48 "	Itching. Joint pains.
6th	99.2°F	60 "	Itching. Joint pains.
8th	N.	48 "	Itching.
10th	98.6°F	24 "	
9th	N.	60 "	Itching.
9th	N.	48 "	Itching.
9th	N.	84 "	Itching.
16th	N.	48 "	
7th	N.	60 "	
8th	99°F	60 "	Itching.
7th	N.	84 "	
8th	N.	28 "	
9th	N.	100 "	Itching.

TABLE I. (Contd.)

Day of appearance of urticaria after administration of serum.	Temperature at onset of urticaria.	Duration of urticaria.	Remarks.
5th	99.4°F	30 hours	
8th	N.	60 "	
8th	100.0°F	26 "	
6th	N.	60 "	Itching. Joint pains
4th	N.	24 "	
12th	99.6°F	48 "	
9th	N.	36 "	Itching.
9th	N.	24 "	
8th	N.	32 "	
10th	98.8°F	40 "	
8th	N.	48 "	
7th	N.	48 "	Itching.
9th	N.	56 "	Itching. Joint pains
10th	100.2°F	96 "	
7th	N.	28 "	Itching.
9th	N.	50 "	Itching.
8th	N.	26 "	
16th	N.	48 "	Itching.
9th	99.2°F	40 "	Itching.
7th	N.	48 "	
8th	N.	60 "	
9th	N.	26 "	
9th	N.	36 "	Itching.
10th	99.0°F	24 "	
8th	N.	60 "	
6th	N.	24 "	Itching.
4th	N.	100 "	Itching.
16th	N.	32 "	
8th	N.	30 "	
8th	100.2°F	84 "	Itching. Joint pains
8th	98.6°F	28 "	
5th	98.8°F	96 "	Itching.
8th	99.8°F	48 "	
10th	N.	28 "	
8th	N.	56 "	
9th	100.2°F	50 "	Itching.
8th	N.	48 "	Itching.
7th	N.	60 "	Itching. Joint pains.
8th	N.	48 "	
9th	99.6°F	24 "	Itching.

TABLE I. (Contd.)

Day of appearance of urticaria after administration of serum.	Temperature at onset of urticaria.	Duration of urticaria.	Remarks.
9th	N.	60 hours	Itching.
8th	98.8°F	48 "	
7th	N.	60 "	Itching. Joint pains
10th	N.	26 "	
9th	N.	60 "	
7th	N.	48 "	
8th	N.	60 "	
5th	N.	120 "	Itching. Joint pains
8th	N.	48 "	
12th	99.4°F	36 "	
6th	N.	24 "	
4th	N.	60 "	
9th	N.	48 "	
9th	N.	84 "	Itching.
8th	100.0°F	60 "	
10th	N.	48 "	
8th	N.	60 "	Itching.
<u>½ c.c. Adrenalin given subcutaneously.</u>			
8th	N.	72 "	Itching.
4th	98.6°F	48 "	
5th	N.	60 "	
9th	N.	60 "	
8th	99.0°F	72 "	Itching.
8th	N.	24 "	
5th	N.	80 "	Itching.
7th	99.2°F	36 "	
9th	N.	72 "	Itching.
11th	99.6°F	48 "	Itching. Joint pains.
11th	N.	72 "	
8th	98.6°F	60 "	Itching. Joint pains.
9th	N.	48 "	
4th	N.	72 "	Itching.
8th	99.4°F	48 "	
9th	N.	60 "	
5th	N.	36 "	
5th	99.6°F	72 "	Itching.
8th	N.	24 "	Itching.
7th	98.8°F	80 "	Itching.

It will be seen that, following the administration of serum, the average time of onset was the eighth day. In isolated cases the rash appeared as early as the fourth and as late as the sixteenth day.

It would appear that a rise of temperature on the appearance of the rash is only to be expected in some 30 per cent. of cases, and further, that a rise in excess of 100°F. is exceptional.

The average duration of the rash was 52.4 hours, and the extremes, 24 and 120 hours.

Marked itching was noted in 42 per cent. of the cases while joint pains were present in 10 per cent.

Itching was, to some extent, relieved by the administration of adrenalin but the drug had no influence on the course of the urticaria.

Cases treated with Ultra-Violet Light.

In Table II are presented the results of the writer's observations on one hundred cases of anti-scarlatinal serum urticaria treated by ultra-violet light. In treating these cases dosage aimed at the production of a marked second degree erythema. The time of exposure varied from three and a half minutes to five minutes at a distance of thirty inches from the lamp.

TABLE II.

	Dose (A Marked 2nd Degree Erythema.)	Duration of Urticaria.	Remarks.
1.	A marked 2nd Degree Erythema <u>Back</u> and <u>Front</u> .	18 hours.	Itching relieved.
2.	"	16 "	
3.	"	32 "	Itching relieved.
4.	"	19 "	Itching relieved.
5.	"	24 "	
6.	"	29 "	Itching relieved.
7.	"	17 "	
8.	"	14 "	
9.	"	20 "	Itching relieved.
10.	"	16 "	Itching relieved.
11.	"	12 "	Itching relieved.
12.	"	16 "	
13.	"	16 "	Itching relieved.
14.	"	24 "	
15.	"	18 "	
16.	"	26 "	Itching relieved.
17.	"	23 "	
18.	"	30 "	Itching relieved.
19.	"	17 "	Itching relieved.
20.	"	28 "	Itching relieved.
21.	"	32 "	

TABLE II. (Contd.)

	Dose (A Marked 2nd Degree Erythema.)	Duration of Urticaria.	Remarks.
22.	A marked 2nd Degree Erythema <u>Back</u> and <u>Front</u> .	27 hours.	Itching relieved.
23.	"	19 "	
24.	"	22 "	Itching relieved.
25.	"	17 "	Itching relieved.
26.	"	16 "	
27.	"	14 "	
28.	"	28 "	
29.	"	30 "	Itching relieved.
30.	"	21 "	Itching relieved.
31.	"	26 "	Itching relieved.
32.	"	24 "	Itching relieved.
33.	"	24 "	
34.	"	28 "	Itching relieved.
35.	"	18 "	Itching relieved.
36.	"	27 "	
37.	"	17 "	Itching relieved.
38.	"	25 "	
39.	"	16 "	Itching relieved.
40.	"	24 "	
41.	"	26 "	
42.	"	20 "	Itching relieved.
43.	"	18 "	
44.	"	12 "	Itching relieved.
45.	"	21 "	Itching relieved.
46.	"	19 "	
47.	"	28 "	Itching relieved.
48.	"	24 "	
49.	"	32 "	
50.	"	30 "	Itching relieved.
51.	"	32 "	Itching relieved.
52.	"	33 "	Itching relieved.
53.	"	27 "	Itching relieved.
54.	"	20 "	Itching relieved.
55.	"	18 "	Itching relieved.
56.	"	19 "	
57.	"	23 "	Itching relieved.
58.	"	25 "	
59.	"	17 "	
60.	"	21 "	Itching relieved.
61.	"	27 "	Itching relieved.

TABLE II. (Contd.)

	Dose (A Marked 2nd Degree Erythema.)	Duration of Urticaria.	Remarks.
62.	A marked 2nd Degree Erythema <u>Back only.</u>	24 hours Back) 36 " Front)	Itching relieved.
63.	"	16 " Back) 22 " Front)	Itching relieved.
64.	"	24 " Back) 36 " Front)	
65.	"	16 " Back) 16 " Front)	
66.	"	22 " Back) 38 " Front)	
67.	"	19 " Back) 30 " Front)	Rash brought to a 'head' on back.
68.	"	23 " Back) 28 " Front)	
69.	"	12 " Back) 28 " Front)	Rash brought to a 'head' on back. Itching relieved.
70.	"	16 " Back) 16 " Front)	
71.	"	21 " Back) 28 " Front)	Itching relieved.
72.	"	21 " Back) 30 " Front)	
73.	"	23 " Back) 38 " Front)	Rash brought to a 'head' on Back. Itching relieved.
74.	"	20 " Back) 27 " Front)	
75.	"	24 " Back) 35 " Front)	Itching relieved.
76.	"	16 " Back) 20 " Front)	
77.	"	29 " Back) 40 " Front)	Itching relieved.
78.	"	24 " Back) 35 " Front)	

TABLE II. (Contd.)

	Dose (A Marked 2nd Degree Erythema.)	Duration of Urticaria.	Remarks.
79.	A marked 2nd Degree Erythema <u>Back only.</u>	16 hours Back) 26 " Front)	Rash brought to a 'head' on back. Itching relieved
80.	"	22 " Back) 30 " Front)	
81.	"	24 " Back) 24 " Front)	
82.	A marked 2nd Degree Erythema <u>Front only.</u>	16 " Front) 26 " Back)	
83.	"	23 " Front) 31 " Back)	Rash brought to a 'head' on front. Itching relieved.
84.	"	12 " Front) 14 " Back)	
85.	"	19 " Front) 24 " Back)	Itching relieved.
86.	"	27 " Front) 38 " Back)	
87.	"	20 " Front) 29 " Back)	Rash brought to a 'head' on front. Itching relieved.
88.	"	19 " Front) 30 " Back)	
89.	"	28 " Front) 41 " Back)	
90.	"	18 " Front) 31 " Back)	Itching relieved.
91.	"	22 " Front) 35 " Back)	Itching relieved.
92.	"	17 " Front) 24 " Back)	
93.	"	19 " Front) 25 " Back)	Rash brought to a 'head' on front. Itching relieved.
94.	"	27 " Front) 29 " Back)	
95.	"	24 " Front) 26 " Back)	
96.	"	24 " Front) 24 " Back)	Itching relieved.
97.	"	17 " Front) 30 " Back)	Itching relieved.
98.	"	22 " Front) 38 " Back)	
99.	"	19 " Front) 33 " Back)	Itching relieved.
100.	"	20 " Front) 35 " Back)	

From Table I and II it is evident that, in the cases irradiated both back and front, the average duration of the urticaria was only 22.3 hours, whereas in those not so irradiated the duration was 52.4 hours.

It is interesting to note that in those cases irradiated on the back or front only, the urticaria had entirely disappeared from that region after an average interval of 21.2 hours, while on the non-irradiated side of the same cases, the eruption persisted for an average period of 29.4 hours.

Formerly regarded as a local dermatitis urticaria is now considered rather as a disturbance of tissue fluids resulting in a cutaneous manifestation. The initial observation leading to this view was made by Vidal in 1911 who showed that the eruption was the last stage in a series of blood vascular disturbances occurring in an individual sensitive to some foreign protein. The type of urticaria considered in this paper may be regarded, therefore, as a clinical cutaneous manifestation secondary to a blood vascular disturbance. This disturbance is set up by the protein element of the anti-scarlatinal serum in an individual unfortunate enough to be a member of a very large group in which the "diathèse colloïdologique" may be demonstrated. These vasomotor disturbances which

produce urticaria are evidence of primary stimulation of the sympathetic nervous system.

The writer considers that the beneficial effects in the treatment of serum urticaria by Ultra-Violet Light are mainly local. These blood vascular changes with exudation of fluid just considered bear a striking similarity to the changes which take place in normal skin on exposure to Ultra-Violet Light already noted on page 16. The writer, therefore, suggests that when a patient suffering from urticaria is exposed to ultra-violet irradiations the rash is quickly brought to full efflorescence thus shortening the course of the disease by an average period of 30.1 hours seen in the cases considered.

The urticarial rash remained for an average period of 8.2 hours longer on that side of the body not exposed to the rays of the lamp. This time, however, is 23 hours less than that taken by the rash to disappear from the control cases. Since it has been shown (page 15) that only a very small percentage of the rays are capable of penetrating the skin and exerting a direct effect on the blood, the writer suggests that the stimulated sympathetic nerves of the irradiated side may induce vasomotor changes reflexly

in the vessels of the non-irradiated side.

Itching was speedily relieved; in some cases before the occurrence of hyperaemia, showing that certain wave lengths are capable of penetrating the nerve endings where they produce direct effects. The patients thus enjoyed longer and more restful sleep.

By exposure of cases suffering from anti-scarlatinal serum urticaria to the rays from a quartz mercury vapour lamp, the writer claims a practical and efficient method of treatment.

Cases receiving Irradiated Serum.

Encouraged by the effect of ultra-violet light in treating cases of anti-scarlatinal serum urticaria the writer decided to observe the effect, if any, of irradiating the serum before injection. For this purpose each dose of anti-scarlatinal serum was placed in a large Petri dish and exposed to the Jesionek Lamp at a distance of eighteen inches for times ranging from five to fifteen minutes; the further to ensure adequate irradiation, the serum was stirred throughout the exposure by means of a sterile glass rod.

One hundred and ten consecutive cases received, intramuscularly, the usual dose of 10 c.c., of this irradiated serum; of these, thirty one or 28.2 per cent. developed urticarial rashes. This figure coincides with the average percentage of serum urticarial incidence (29 per cent. noted on page (27) and represents little reduction in incidence.

The writer further noted that in the cases which received the irradiated serum, and which developed urticaria, the rash appeared, on an average, at the ninth day and lasted 47.8 hours; these results are in contrast with the appearance of the urticaria on the eighth day, and the average duration of 52.4 hours, in

the cases receiving untreated serum (Table I).

In Table III are shown details of the thirty one cases which developed urticaria after receiving irradiated serum.

TABLE III.

Day of appearance of urticaria.	Serum irradiated for:-	Temperature.	Duration of Urticaria.	Remarks.
8th	5 minutes at 18 inches.	N.	72 hours.	General well marked urticaria. Itching.
11th	"	N.	48 "	Slight urticaria.
7th	"	99.2 ^o F	84 "	General well marked urticaria. Itching.
8th	"	N.	36 "	Slight urticaria.
6th	"	N.	48 "	Slight urticaria.
11th	"	N.	36 "	Moderate urticaria.
4th	"	N.	60 "	Slight urticaria.
9th	"	N.	36 "	Slight urticaria.
12th	10 minutes at 18 inches.	N.	48 "	Itching moderate.
7th	"	N.	47 "	General well marked urticaria. Itching.
8th	"	99.8 ^o F	53 "	Slight urticaria.
9th	"	N.	36 "	Moderate urticaria. Itching.
13th	"	N.	48 "	Slight urticaria. No itching.

TABLE III (Contd.)

Day of appearance of urticaria.	Serum irradiated for:-	Temperature.	Duration of Urticaria.	Remarks.
9th	10 minutes at 18 inches.	N.	36 hours.	Slight urticaria. No itching.
8th	"	N.	24 "	Slight urticaria.
9th	"	N.	36 "	No itching.
7th	"	N.	26 "	Slight urticaria.
11th	"	99.6°F	70 "	Itching moderate.
8th	"	N.	72 "	Slight urticaria. No itching.
11th	15 minutes at 18 inches.	N.	48 "	Itching present
6th	"	N.	57 "	Moderate urticaria. Itching.
8th	"	N.	24 "	Slight urticaria. No itching.
10th	"	N.	40 "	Moderate urticaria. Itching.
5th	"	N.	39 "	Slight urticaria.
11th	"	N.	60 "	Moderate urticaria. Itching.
14th	"	N.	48 "	Slight urticaria.
9th	"	N.	58 "	Itching. Present.
12th	"	99.0°F	56 "	No itching.
8th	"	N.	40 "	Moderate urticaria. Itching.
10th	"	99.8°F	65 "	Moderate urticaria. Itching.
13th	"	N.	31 "	Slight urticaria.

In the majority of the cases the rash was less severe

and itching was not so marked as in those which received untreated serum. (Vide Table I).

The temperature of 16.1 per cent. of these cases became elevated on the appearance of the urticaria. This is in contrast with 30 per cent. of the cases shown on Table I.

The writer was unable to demonstrate, unequivocally, any alteration in the therapeutic effect of the irradiated serum and, the suggestion is offered that, as a result of its exposure to the ultra-violet radiations, possibly the globulin fraction of the serum underwent some change without the associated antitoxic properties being in any way affected.

It would appear, from this part of the investigation, that the direct method of treating serum urticaria with ultra-violet light is best, but irradiated serum has some advantages over unirradiated. The incidence of urticaria among those receiving irradiated serum, as compared with that of those receiving untreated serum showed little difference, but the average duration of the rash in the former cases was diminished by 4.6 hours. Although not available to arithmetic precision it can be stated, with confidence, that the intensity and irritability of the rash are much less when irradiated serum is used.

SUMMARY AND CONCLUSIONS.

A study of a series of unselected cases of scarlet fever has been carried out with the object of demonstrating in this disease the effect of exposure to ultra-violet light upon the course, specific characteristics, and complications. For this purpose observations upon one hundred and eighty seven cases are set out and the relevant positive findings are controlled by parallel series each of similar numbers of cases, (a) which received no specific treatment, and (b) which were treated by antiscarlatinal serum.

With the further aim of investigating the effect of irradiation upon the incidence and nature of serum urticaria one hundred cases showing this allergic manifestation were treated by ultra-violet light; the facts emerging from this procedure are controlled by comparison with a further group of one hundred cases not so treated.

In the production of urticaria the relative potency of antidiphtheritic and antiscarlatinal sera has been observed in one hundred cases of diphtheria and in one hundred cases of scarlet fever, all of which received in treatment approximately equal volumes of the appropriate antiserum. The possibility of modifying, by preliminary irradiation, the allergic

potentiality of serum has been probed in one hundred and ten cases receiving serum thus prepared.

The observed facts as set out in the foregoing pages would appear to justify the following conclusions.

1. Irradiations from a quartz mercury vapour lamp are entirely without effect on the duration of the rash of scarlet fever.

It is to be noted, however, that, when viewed under the lamp, the characteristics of the rash are accentuated and that in this medium they remain visible for an appreciably longer time than when viewed in ordinary white light, and the mercury vapour lamp has thus a definite value as an aid to the diagnosis of doubtful rashes.

2. Despite the fact that the fall of temperature of acute scarlet fever cases is uninfluenced by exposure to ultra-violet light, it is desirable that the initial temperature of the patient be allowed to become normal before exposure to the lamp. (vide infra 5).

3. Although the general well being of the patient is improved the actual duration of the disease

is unaffected by exposure to ultra-violet light.

4. Ultra-violet light has little or no effect on the normal course of scarlatinal desquamation.
5. Exposure of scarlet fever patients to ultra-violet irradiations diminishes the tendency to develop septic sores, otorrhoea and rhinitis. The incidence of nephritis is unaltered provided, as in (2), irradiation is commenced after the initial temperature has settled. Other common complications are unaffected. Although it is unwise to draw conclusions from the happy outcome of isolated cases, the rapid cure of a single instance of erythema nodosum, a condition notoriously refractory to treatment, amply justifies the massive doses utilised and offers a useful suggestion for a routine procedure in this condition.
6. Following the use of antiscarlatinal serum the liability to urticaria is greater than in the case of antidiphtheritic serum, while the developed rash is more irritable and of longer duration.

7. Cutaneous allergy to antiscarlatinal serum occurs usually on or about the eighth day, has an average duration of 52.4 hours, is accompanied by itching in 42 per cent. of cases, and by joint pains in 10 per cent.

8. In the treatment of serum urticaria ultra-violet irradiation with the quartz mercury vapour lamp is of undoubted value - itching is promptly relieved, and the duration of the urticaria diminished by an average period of 30.1 hours.

The local and systemic effects of the rays are seen to best advantage when dosage is pushed to the production of a second degree erythema only.

9. Preliminary irradiation of the serum produces no difference in the incidence of urticaria, delays its appearance for approximately one day, shortens its duration by 4.6 hours, modifies markedly its irritability and diminishes any associated rise in temperature by 13.9 per cent. Preliminary irradiation of the serum is apparently not inimical to its antitoxic properties

and therapeutic value.

In concluding this paper I have to acknowledge indebtedness to Dr. C. Barclay Reekie by whose kind permission I have had free access to the clinical material in the wards under his control, and to Dr. J. Struthers Fulton for his helpful suggestions.

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