

*Ultra-violet Radiation in Mental Hospital Practice: A Preliminary Survey.\** By K. K. DRURY, M.C., M.D., D.P.M., Deputy Medical Superintendent, County Mental Hospital, Stafford.

THE subject of artificial heliotherapy is at present attracting much attention in both scientific and lay worlds. The Board of Control report for 1925 states that there were only five installations in mental hospitals at that time, but doubtless there are more now. I venture therefore to place before you some notes on ultra-violet therapy in the hope that they may be of interest to those thinking of taking up this line of work; and that by their criticisms and observations I may learn from those who have already done so.

Radiant energy was studied by the ancients—the fact of the photo-chemical action of light was noted by Aristotle in 350 B.C. It was not, however, until Newton in 1666, by his epoch-making discovery, showed that white light is composed of the various colours forming the spectrum, that rapid progress was achieved, especially in the nineteenth century by men such as Bunsen and Roscoe.

The first great step after Newton's discovery was made ten years later by Römer, a Dane, who proved that light had a definite velocity. Early as this discovery was made, and inadequate as instruments were in those days, his estimate was only about 3% different from that accepted to-day as accurate, *viz.*, 186,300 miles, or 300 million metres per second. This was an observation of the first magnitude, and governs our calculations in the whole realm of radiation.

Perhaps the greatest mind, so far, in the sphere of theoretical physics was that of Clerk Maxwell (1868), for he showed the way for the practical work of Hertz, Marconi and others on the infra-red or long wave side of the visible spectrum, and for that of Röntgen on the ultra-violet side, though the former was known to the elder Herschel in 1800, and the latter to Ritter in 1801.

Before the advent of practical electricity, the sun was the only known source of ultra-violet radiation at our disposal, and it is hardly necessary to draw attention to the fact that it was only during the past century that mankind has again begun to appreciate the value of sunlight as a curative as well as a preventive agent. The ancients knew and appreciated this power, but our more immediate ancestors did their best to forget it.

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Light falling at right angles to the surface exerts its maximum activity which diminishes as the angle becomes less than a right angle. In our latitude, therefore, and also on account of the absorption of the shorter and, therapeutically, more active waves by fog, smoke or other extraneous matter, sunlight in this country is unreliable and often unobtainable. Our attention, perforce, is directed to the production by artificial means of a source of radiation giving wave bands similar or even more useful, therapeutically, than those from the sun. Electric arcs provide the source of such radiations conveniently and economically.

There are three main types in use to-day. They are (1) the carbon arc, (2) the tungsten arc, (3) the mercury vapour arc.

These lamps all give the needed rays in varying intensities, and their spectra have been recorded by means of suitable spectroscopes.

*The carbon arc.*—This was the first artificial means employed to produce ultra-violet rays, and was introduced by Finsen in 1893, and is almost exclusively used at the Finsen Institute in Copenhagen. The therapeutic value of the arc is said to have been first noticed by a man suffering from rheumatism, who had to work for a long period in the direct rays of a powerful arc and found himself much benefited thereby. Carbon arcs are much used for the general irradiation of large areas and several patients may be treated at once, but to be adapted for local treatment they must be water-cooled. Carbon arcs are expensive both in prime cost as well as running expenses, and they need a great deal of attention from an electrical standpoint.

*The tungsten arc.*—This arc is struck between rods of pure compressed tungsten and occasionally between carbon rods cored with tungsten. It is apt to splutter and burn unevenly and needs a good deal of attention. To my mind it is not a very suitable type for our purpose.

Other arcs of the air-burning type include those with iron electrodes. Sir Henry Gauvain (1) reports that he has found these to be of considerable value at Alton.

*Mercury vapour lamps.*—The mercury must be held in a container that is both able to transmit the higher frequencies as well as to withstand the great heat of the arc. The container generally used in medical work is a tube made of fused quartz of the best quality. The lamp is made in three chief types, namely: (1) The vacuum tube type, (a) air-cooled, and (b) water-cooled; (2) the atmospheric type, air-cooled.

The vacuum type has several disadvantages. Firstly, air gradually enters the tube where the electrodes have been sealed in. Secondly,

the mercury lies free in the vacuum and "hammers" if moved, and breaks the quartz tube. Thirdly, the inside of the tube becomes dirty with use, and it is an expensive and troublesome process to break the vacuum, clean the tube and mercury and re-establish the vacuum. Finally, in this type of lamp it is often difficult to break the arc.

Water-cooled mercury vapour lamps are only useful for purely local work, and are therefore not of much interest from the mental hospital standpoint.

This leaves the third or atmospheric air-cooled type, which many authorities find the simplest, cheapest and, in the long run, the most convenient type for general or fairly local application. It appears to be the choice of those who are doing the greatest amount of both practical and research work, and in every way seems best suited to the needs of a mental hospital. It is said to be less productive of malaise than carbon arcs in those who are very sensitive to light, though they may not react by marked erythema.

The mercury in the tube being at atmospheric pressure no "hammer" action takes place, and the tube may be easily cleaned inside by even inexpert people.

The breaking of the arc is automatically performed in the lamp of this type chosen for use at Stafford, the makers being Messrs. Kelvin, Bottomly & Baird, of London.

There are no noxious fumes, spluttering or great heat. The quartz tube must be cleaned daily with a little Sp. vini rect., must not be touched with the fingers, and needs to be protected from dust as far as possible.

Treatment is carried out in a small room some 15 ft. square, with access from a similar dressing-room through a wide curtained opening. Both rooms are close to the centre block, which facilitates treatment to either male or female patients. The æsthetic effect of both rooms is helped by restful wall decoration, coloured curtains, thick cork lino floor covering, and bright electric radiators in each room.

Accessories consist of wall thermometer, time-exposure alarm clock, slip drawers for patients, measuring rods (20, 30 and 40 in. long), and goggles for patients as well as operators. These protective devices are essential for all, as eye-strain with conjunctivitis is a very real danger.

In addition to goggles, a pair of "Crookes" glasses, type A2, fitted in strong spectacle frames provided with side shields, are useful for the operator when attending the meters, clock or day-book. These glasses give adequate protection from indirect rays reflected from walls and other objects, as they only transmit a

minimum of ultra-violet rays, as well as cutting off some 22% of the incident total light chiefly at the red end of the spectrum. A day-book records the patient's name, part exposed, time of exposure and distance from the lamp.

What actually are we attempting to do when we expose patients to ultra-violet rays? We know by experience that we ultimately benefit their general physical condition, while incidentally increasing the bactericidal power (2) of the blood and improving the calcium metabolism of the body.

Other phenomena are indefinite, including the psychological effect, a feeling of well-being and an increased intellectual output.(3) Certain phenomena are known to take place *in vitro*, amongst which are the lethal effects on infusoria, the power of re-creating the vitamine content in sterilized milk, the increased fertility of seeds exposed to the rays, and their photo-chemical power.

I do not propose to discuss the theories advanced to show how the rays are absorbed into the body. There are two theories—one that the action is vibratory, the other photo-chemical.

The whole subject of dosage and skin reaction is paradoxical.

The skin exposed to the rays reacts apparently to protect itself from them by desquamation and pigmentation, gradually becoming nearly immune, and unless the skin is rested, or the dose is greatly increased, no effect is produced so far as we can see. And yet we know the rays do good. Why, then, does the skin act as it does? So far, experimenters have found that the best results are got by exposures causing a definite but mild erythema of the skin.(4)

The Copenhagen school advocate total exposure to large and increasing doses. The recent work of Eidinow (5) tends to show that his technique achieves more economically the increased bactericidal power of the blood. He exposes parts of the body in turn, producing on each a definite mild erythema, and then allowing sufficient rest to restore the skin to its former sensitivity. The patient is exposed three times a week, only approximately one-quarter being exposed at a time; each part then gets nine or ten days' rest for recovery, this, in practice, proving ample. Much time and expense is saved, and so far he shows positive results.

Such a procedure is also advocated by Peacock (6), and, if adopted in mental hospital work, would allow a much larger number of patients to gain the undoubted benefit of exposure to the rays, and incidentally save the time of the nursing staff and medical officers.

In gauging the time for exposure, the known factors are :

1. The distance from the source of the light. The intensity varies as the inverse square of the distance. (This law is

repudiated by some (7), but strong proof to the contrary will be necessary before the old theory is given up.)

2. The angle of incidence of the rays. Rays falling at right angles are more intense than those at an acute angle; the ratio complies with the Cosine Law.

3. The temperature of the skin. The use of rays from carbon filament incandescent lamps suitably directed on the parts to be exposed to the arc is advocated. The room temperature must be constant and comfortably high.

Taking the emission of the lamp to be constant (and Walters (8) has shown that the mercury vapour lamp requires a preliminary time of 15 minutes before its emission becomes steady), the variable factor is the idiosyncrasy of the patient. This is best investigated by means of the "spot" test. Small areas of the skin, the size of a florin, at some usually covered place—*i.e.*, abdomen or upper arm—are exposed at a known distance from the rays for definite periods, and the result noted some 12 hours later, the exact therapeutic dose being then easily calculated.

In general, females are said to react more than males, blondes more than those dark-complexioned, clear-skinned more than greasy. An easily bruised white, thin skin reacts most readily.

An easy way of detecting light sensitiveness is by transillumination of the air sinuses or skin. A very brilliant "red reflex" on ophthalmoscopic examination often signifies sensitiveness to light.(9)

The spot test is also usefully employed to gauge the sensitivity of various areas of the body. McKenzie and King (10) state that the order of sensitivity is: (1) Inner surface of the thighs, (2) dorsal aspect of the trunk, (3) outer surfaces of thighs, legs, arms, hands, feet, and lastly scalp.

Before exposing any patient, the physical condition must not be overlooked. Heart disease, phthisis, low blood-pressure or raised temperature are conditions that call for the greatest caution before deciding on exposure.

When making an exposure, the patient lies on a couch or reclines in a deck chair, assuming a position from the lamp as measured by one of the rods already mentioned. Insensitive parts may be a little nearer than those less so. Deck chairs are very convenient for general exposures, the body naturally taking up an easy curve, the lamp being placed somewhat nearer the feet than the chest.

Confidence in treatment, so valuable psychologically, is easily obtained. The feeling of well-being is so strong that all patients evince a desire for further treatment after the first exposure. I

have noticed acute maniacs, so commonly insensible to their surroundings and comfort, lie back quietly and exclaim how comforting they find the rays.

For local treatment the patient is arranged as is most convenient, but I believe that general treatment should always be given as well.

Before actual exposures are made with a new lamp, the intensity of its emission should be tested. As the emission drops with the age (hours of use) of the lamp, the tests must be repeated at intervals and the results noted. Increased doses will be necessary to compensate for the drop, and, later, cleaning of the mercury and the inside of the quartz container will have to be undertaken. As mentioned before, the tube must be kept scrupulously clean and not touched, or else greasy finger-marks and dirt will be burnt into the quartz. Such marks form an impassable barrier to the rays, and, if numerous, may necessitate a new burner.

There are various methods available for testing the emission, and they are described in detail in any good text-book.

I will mention only two, the most and least expensive. The former is a light-sensitive cell used in conjunction with an electro-scope (11), the apparatus costing ten guineas. The cheapest is supplied by Arnolds, of London, using the Levy-West ultra-violet pastilles (12). These pastilles change colour when exposed to ultra-violet rays, the depth of darkening being compared with a tint card supplied. The outfit costs fifteen shillings. I have used both, and the less expensive apparatus appears sufficiently sensitive for ordinary use.

A simple experiment, yielding curious results that require further investigation, was carried out as follows: Twenty-five nurses, a similar number of attendants, together with 25 patients of each sex, volunteered for a "spot" test. Each normal was paired with an apparently healthy patient, chosen for similarity of coloration, texture and type of skin. Conditions were identical for all, but many patients were found to possess a markedly greater degree of sensitivity to the rays than the normals. In detail the results were:

18 patients, or 36%, showed in an equal degree of reaction with the paired normal.

5 patients, or 10%, showed in a definite degree less reaction than the paired normal.

27 patients, or 54%, showed in a definite degree more reaction than the paired normal.

These results came as a surprise to me. I had imagined the opposite to be true. Until further research has been done I do not

venture any explanation, though it may well lie in a disturbance of the sympathetic nervous system.

Occupation and outdoor life are not the causes of the discrepancy, for the biggest differences in reaction took place between attendants who work chiefly outside and patients who had an exceptionally active outdoor life. The results between normals themselves as well as between patients show most marked variances. Apart from all other considerations, the experiment serves to emphasize the need for the greatest caution when exposing anyone for the first time, and the desirability of a preliminary "spot" test in all cases.

I think it will be agreed that most mental cases have a greater chance of recovery when their physical condition is good, and I firmly believe that in ultra-violet radiations we have a powerful aid to this end. Nevertheless the more usual therapeutic aids must on no account be omitted.

Since the lamp was installed I have given all suitable new admissions, and some previous but recent cases, a thorough course of light-baths. The cases treated embrace examples of the principal mental diseases.

The results to date are promising, with three exceptions. The exceptions are agitated melancholics, acute maniacs and epileptics. These classes do not benefit mentally—in fact appear to become worse. The maniacs and cases presenting maniacal features become quieter during exposure, but immediately afterwards become more and more restless and noisy. It is questionable if it is even desirable to expose those cases where the mental state is causing severe physical exhaustion.

Cases of epilepsy improve physically, but the fits are increased in number and the patients appear to recognize this and blame the lamp. Cases so far treated over a period of one month show increases varying from 20 to 150% in the number of fits over the previous month.

The physical condition of the precocious dements shows improvement from radiation, in particular the catatonic cyanosed cases. So far as I have observed, there is no concurrent mental amelioration, though some become more talkative and exhibit more body movement than before.

Quiet delusional cases have shown little mental change, but the irritable type are more amenable.

The large class of admissions comprising the simple melancholias, manic-depressives and confused cases appear to benefit from ultra-violet radiation. It is difficult to assess the benefit of any line of treatment, but it is a pleasure to watch these cases gaining health

in a steady manner and looking forward to their treatment. The physical condition of this type of patient is usually bad, and it is on this account I feel that the ultra-violet rays are so useful. It is not possible to say definitely if the rays are as serviceable as they appear to be until statistics have shown if the average length of stay in hospital is shortened or the recovery-rate improved.

So far, no cases of general paralysis have been radiated.

In general, these results agree closely with those published by Dr. Cormac of Parkside, in the Board of Control's Report for 1925.

The case of an elderly melancholic with high blood-pressure is a good example of the mental outlook of patients to treatment. At first he bemoaned his fate and the uselessness of any treatment. Later he said he felt no worse, and eventually he admitted he felt better, and certainly his demeanour had greatly improved; his blood-pressure fell from 230 to 190 mm. Hg. in 14 exposures spread over six weeks.

The lists of physical ailments said to be cured, or at least benefited by ultra-violet radiation, rival those in the Sunday papers by vendors of patent medicines. The Russells, in their book, give a list of 143 separate diseases in which good results have been claimed by various workers. I have already treated a good many conditions with a large measure of success. Rheumatism, chronic bronchitis and asthma, alopecia, acneform eruptions, eczema, indolent ulcers and tubercular glands have all yielded with gratifying results. A pre-tubercular melancholic, with chronic eczema of his legs, who was rapidly going downhill, has regained his health to a remarkable degree; his mental state has also improved. Two cases of psoriasis have so far been treated, but without definite change: many observers have reported cures from ultra-violet treatment, but it is well to remember that this surprising disease has yielded to treatments so diverse as milk diet and psycho-analysis!

Perhaps the most interesting case of all from a clinical standpoint was one of pellagra:

Towards the end of August this case (admitted on March 8, 1926, suffering from mania) was rapidly nearing her end. Severe terminal diarrhoea had set in and there was most pronounced debility and wasting. The typical skin-lesions were marked, and in general the epidermis was hard, brittle and shrunken. Mentally she was nearly comatose. On August 26 treatment was commenced rather as a forlorn hope. On September 3, after four exposures, the diarrhoea had ceased, and the skin was more supple with the lesions less marked. On September 10 she could stand unaided and answered simple questions. Treatment with improvement continued until October 12, when she had had 19 exposures. Unfortunately, she suffered from heart disease (mitral stenosis), and on October 14 she died rather suddenly from this complaint. She had eaten a good dinner about half an hour previously and was sitting up in bed talking when the end came. The improvement in this case was very marked. She had put on weight, the skin had become soft and pliable while the lesions had completely faded. The *post-mortem* findings,



apart from the heart, showed chiefly an old-standing inflammation of the mucosa of the whole gut. A macroscopic examination of the brain showed some sclerosis of the white matter.

Radiation appears to have a very definite power of restoring the deficiency. This result is in line with the latest research work in vitamins and ultra-violet rays.

No account of ultra-violet therapy in mental hospital work would be complete without mention of a new glazing material called Lamplough's "vitaglass." Ordinary window-glass cuts off the majority of the ultra-violet rays in sunlight, but they pass freely through vitaglass. The daily press has given accounts of the benefits derived from its use in the London Zoological Gardens. The Chief School Medical Officer of Birmingham reports favourably on its use in schools in his area. It is being extensively used in new factories and on pedigree stock farms; one gentleman has lately ordered 1000 ft. super. to glaze sheds for his pedigree prize cows. Unfortunately its cost is high, but I certainly think it should be used for all verandahs and admission wards in our hospitals.

I think that it is desirable that accurate records of weight, pulse, blood-pressure, hæmoglobin content and white cell differential count should be made in all cases undergoing general treatment. I know this entails a formidable amount of work, but in the interests of science it should be done. With co-operation, it should not be too difficult a task for the medical officers of a mental hospital to carry out.

With regard to the operation of the lamp and supervision of treatment, I think the preliminary tests and first treatment of any patient should be carried out by the medical officer concerned, but that subsequent treatments could be satisfactorily done by a trained nurse under the general supervision of the medical officer.

In conclusion, I believe that, with the exception of agitated melancholics and acute maniacs and epileptics, the majority of mental cases (treatment not being contra-indicated by the physical state), will benefit by radiation, the mental gain being due to the improved physical state.

I have to thank Dr. Shaw, Medical Superintendent of the County Mental Hospital, Stafford, for his permission to publish these notes, as well as for help and advice in the selection and treatment of the patients.

*References.*—(1) Gauvain, *Lancet*, ii, 1925, p. 11.—(2) L. Hill, Eidinow and Colebrook, *Brit. Journ. Exper. Path.*, 1924, v, p. 54.—(3) *Med. Ann.*, 1925, p. 515.—(4) Eidinow, *Lancet*, 1925, ii, p. 320.—(5) *Idem, ibid.*, 1926, ii, p. 645.—(6) Peacock, *ibid.*, 1925, ii, p. 396.—(7) *Idem, ibid.*, ii, 1925, p. 396.—(8) Walters, *ibid.*, 1925, ii, p. 1183.—(9) Eidinow, *ibid.*, 1925, ii, p. 320.—(10) McKenzie and King, *Practical Ultra-violet Light Therapy*.—(11) Griffith and Taylor, *Lancet*, 1925, ii, p. 1205.—(12) *Ibid.*, 1926, ii, p. 838.

[A summary of the clinical form in use at Parkside Mental Hospital, Macclesfield, in regard to ultra-violet treatment is added by kind permission of Dr. Dove Cormac :

Name		Sex	Age
Date	Height	Mental condition	
Blood-pressure (3 lines—left): (1) at commencement, (2) at end of 4th week, (3) at end of 8th week.			
Basal metabolic rate (same 3 lines—right): (1) at commencement, (2) at end of 4th week, (3) at end of 8th week.			
Bodily disease (1 line).			
General condition (2 lines).			
Blood-count (6 lines—left). Weight (right), 1st, 2nd, 3rd and 4th weeks.			
Date.	Period of exposure.	Date.	Period of exposure.
		Condition.	Weekly notes on—
		(20 lines.)	Pigmentation. Mental state.
Blood-count at end of 4th week (6 lines).—Eds.]			

*The Care and Management of Induced Malaria.* By W. D. NICOL, M.R.C.S., L.R.C.P., D.P.M. Assistant Medical Officer, Horton Mental Hospital.

For the treatment of general paralysis of the insane by induced malaria, the Board of Control, in consultation with the Ministry of Health, decided, at the end of 1924, to make an official arrangement by which a pure strain of the benign tertian malaria parasite would be cultivated in mosquitoes, and would be made available for inoculation by mosquito-bites instead of by the direct inoculation of blood from other patients. In consultation with the Mental Hospitals Department of the London County Council, the Horton Mental Hospital was selected for the work of preparing and maintaining the strain of malaria in mosquitoes, and Col. J. R. Lord, *C.B.E.*, Medical Superintendent of the Hospital, undertook the necessary arrangements in collaboration with Col. S. P. James, of the Medical Staff of the Ministry of Health. An isolated villa in the hospital grounds was selected as a treatment-block and laboratory; the Horton Mental Hospital authorities caused it to be mosquito-proofed and furnished, and the Ministry of Health supplied the scientific equipment of the laboratory. The Ministry also arranged that the routine laboratory work should be done by one of their laboratory assistants, Mr. P. G. Shute, under Col. James's supervision. I undertook the selection of cases suitable for treatment and their clinical care and management. The arrangements were completed in April, 1925, and since that month 33 batches of infected mosquitoes have been prepared and utilized for the inoculation of more than 300 patients in 69 hospitals in England, Wales and Scotland.

In 1926 the treatment block and laboratory were visited by