THE RÔLE OF LIGHT

IN THE

PREVENTION AND CURE OF DISEASE.*

BY

PERCY HALL, M.R.C.S., L.R.C.P. LOND.,

HON. ACTINO-THERAPIST, THE MOUNT VERNON HOSPITAL; HON.
CONSULTING PHYSICIAN TO THE HULL MUNICIPAL LIGHT CLINIC.

ONLY during the last few years—principally owing to the work of Rollier—has attention been drawn to the value of sunlight as a curative agent. Sunlight is but one form of radiant energy, over 90 per cent. of that which is available on this planet coming directly or indirectly from the sun. What we term sunlight comprises but one octave, which, measured in terms of Ångström units, ranges from 7500 at the red end to 3900 at the violet end. The wave-lengths above and below these units are not visible to the human eye. At the one end we have the ultra-violet and the other, the infra-red or heat rays.

It has been abundantly proved that the part of the solar spectrum which is most concerned in the cure of such diseases as tuberculosis, where heliotherapy is practised, is the ultra-violet region. Physicists have mapped out three octaves of ultra-violet, but the best sunlight available in the high Alps only contains half an octave—the rest being absorbed by the atmosphere. Here in this country we have much less. Ultra-violet rays are easily absorbed and dust, dirt, smoke, and moisture effectually filter out such as would otherwise reach us. For us, therefore, excepting in a few favoured parts of the country and then only in a few months of the year, the natural sun-cure is an impossibility. But much can be done to improve matters. Preventive medicine is much more important than curative. Diseases such as tuberculosis and rickets thrive most and are more prevalent in the crowded industrial towns and cities of the North and Midlands.

There can be no doubt that this is largely due to the atmospheric smoke pollution from our domestic and factory chimneys. By our wasteful methods of coal consumption in open grates and in factory furnaces we so pollute the air of our towns and cities with smoke, as to rob such sunlight as does reach us of its most beneficent qualities, as well as filling the air which we breathe with irritating particles of carbon and other deleterious matter, so causing a great deal of respiratory trouble. The amount of sickness and loss of life caused by atmospheric smoke pollution, if estimated in terms of money, amounts to an appalling sum per annum.

It is said that the production and marketing of a smokeless fuel is not, as yet, a "commercial proposition." By which is meant that its general

manufacture and national use would not be profitable in the narrower sense of the word. But surely the national health is above such a sordid standard.

Sunlight is essential alike to both plant and animal life and, directly or indirectly, is the source of almost all our available energy. The vegetables, cereals, and fruits which form the carbohydrate part of our diet require sunlight in order to develop. Other forms of vegetable life provide the necessary food for our sheep and cattle. If such is deprived of a sufficiency of sunlight the animal part of our diet suffers. In fact, by smoke pollution and deprivation of sunlight, vicious circles are established which affect our health in a serious manner. Cows particularly suffer and become tuberculous, and through their milk infect our children.

I have long maintained that the so-called vitamins so essential to health are not chemical substances, but forms of vital cellular activity which owe their presence in foodstuffs to the action of sunlight; and have believed that one of the therapeutic effects of ultra-violet rays lay in their powers of enabling the body to some extent to synthesise its own vitamins. The recent research of Prof. Baly, of Liverpool, has now practically established this. Recent experiments have shown that vegetable oils exposed to the emanations of the mercury-vapour lamp are charged thereby with anti-rachitic properties equal to cod-liver oil. Indeed, the oils so irradiated resemble cod-liver oil so much in colour and odour that the term "jecorisation" has been employed for this process.

PHYSIOLOGICAL EFFECTS OF LIGHT.

Much research work has been done of recent years on the physiological and biological effects of light upon the human organism. Sonne, in Copenhagen, and Dr. Leonard Hill in this country, are two outstanding workers. Other observers have demonstrated various facts and have made deductions. It has been proved that luminous light is absorbed by the deeper layers of the skin, the subcutaneous, and, possibly, the muscular tissues, as well as by the hæmoglobin and corpuscles of the blood stream. This luminous light is, on absorption, transformed into heat. It has no doubt other effects of which we are at present only dimly aware. We know that the ultra-violet rays—even the longer ones—can only penetrate as far as the deeper layers of the skin. There they are stopped and absorbed by the melanin granules of pigment and by the blood circulating in the capillaries and interspaces.

But very profound biological processes are set up. Dr. Leonard Hill has conclusively demonstrated, for example, that the natural power of the blood to destroy pathogenic organisms is immensely increased even by one short exposure to ultra-violet light from an artificial source. So that now, when we set out to cure disease by exposure to light, we do not expose the local lesion alone, but as much of the surface of the body as is possible—doing it, of

* An Address delivered at the Royal Institute of Public Health Dec 9th, 1925.

course, by slow degrees. The metabolism of the body as a whole is stimulated, and this stimulation is increased if the body is exposed to cool, fresh, moving air. We all know the cheerful effect a bright, sunny day has upon our spirits and how much "fitter" we feel, just as we feel a corresponding depression in both mind and body during dull, cloudy, and foggy weather.

Niels Finsen—the pioneer of ultra-violet light therapy—found that the best way to cure lupus was to expose his patients to the sun, at a high altitude. But he found that even in Denmark there was not sufficient sunlight, and so he sought for an artificial substitute and designed the lamp which bears his name.

People sometimes ask how it is, if sunlight is so good for health, that in tropical regions, where there is a superabundance of sun, disease of all kinds is prevalent. There are many reasons. To begin with, it may be stated in general terms that extremes of all kinds are bad. Further, the tropical sunlight contains an excess of heat rays. These heat rays, by heating the air and ground, heat the bodies of inhabitants both by convection and conduction, as well as by radiation. The harmful effect of the tropical sun is felt most on the plains. There the air is usually stagnant and often highly charged with moisture. In the hills a different condition prevails and life is healthy.

The native races are protected from over-absorption of sunlight by the amount of pigment in their skins. Such diseases as flourish are frequently due to the poor dwellings of the natives and their low standard of living. The health of white people in the tropics may be quite good if they avoid the sun during the hotter parts of the day. Here, at home, and in the Alps, the midday sun is harmful owing to its relatively higher content in heat rays. Heliotherapy is best practised in the early morning and late afternoon, when the ultra-violet content of the sunlight is relatively greater. In the Alps, owing to the pure dry air and prevailing breezes a greater proportion of ultra-violet rays reaches the patient. Further, the snow absorbs the heat rays, whilst at the same time it reflects the luminous and ultra-violet rays. Similarly does water absorb the heat rays and reflect the ultra-violet rays. Consequently the sun cure in flat countries is best practised at the seaside. Again, the absence of smoke and other dark clouds in the Alpine regions is favourable to the sun cure, for the blue sky reflects the ultra-violet and luminous rays, but not the heat rays. So that "sky shine" is of very great importance.

HELIO THERAPY AND ITS CONTRA-INDICATIONS.

To sum up, one may state that the most favourable conditions for the practice of the "Sun cure" are: (1) High altitude; (2) pure, clean atmosphere; (3) moving air; (4) absence of clouds; (5) blue sky; (6) the seaside; (7) early morning sunlight the best.

The contra-indications to the "Sun cure" may be deduced from what has been already written. (1) Febrile conditions; (2) patients in whom there is marked absence of natural pigment—e.g., albinos and very blonde persons; (3) patients whose metabolism and general defensive mechanism is already being strained to breaking point—e.g., grave cachexias, diabetes.

These various conditions—whilst not necessarily absolute contra-indications—mean that such cases should never be treated by heliotherapy except under highly skilled medical supervision and most careful and continuous observation. Indeed, actinotherapy—whether natural or artificial—should never be administered save under skilled medical supervision.

I desire to utter this warning in the gravest possible terms. It cannot be given wide enough publicity. There is a daily increase in the numbers of nurses, masseurs, and others who are opening clinics and establishments for the treatment of patients by ultra-violet light. Disastrous results are certain to follow and will react upon those medical men who are foolish enough to permit their patients to seek treatment at the hands of these unskilled operators.

There is only one safe rule and that is to proceed slowly. Dr. Rollier begins treatment by very gradual exposures. At first the hands and feet are alone exposed for a few minutes. Day by day—according to the reaction obtained—more and more of the body is exposed to the direct rays of the sun, and for gradually increasing periods. The head and eyes are protected by a light, wide-brimmed linen hat and a loin-cloth is worn.

Children suffering from active tuberculous disease of joints have these joints lightly splinted and are exposed as they lie in their beds, on verandahs. At his "School in the Sun," in the Vaudois Valley of the high Alps, Dr. Rollier receives children from all parts of Europe who are debilitated, recovering from measles and whooping-cough, whose proper growth is retarded, and who are regarded as being in pre-tuberculous states. Very soon after their arrival these children—poor, unhappy, pale, sickly, and under-developed little creatures—expand as do the flowers of the spring when they turn their faces to the sun—and may be seen, in a few weeks, completely metamorphosed. Clad only in sandals, loin cloth, and light hats, they can be seen, brown as berries, in mid-winter, playing joyously amid the snow and ice, radiating health and happiness, and happy as children ought to be.

It has already been said that from a curative point of view heliotherapy is impracticable in this country, save in a few highly-favoured parts—such as the South Coast—and even there for only a small portion of the year. But in the industrial towns and cities of the Midlands and North of England, and of Scotland, are hundreds of thousands of cases of rickets, tuberculosis, lupus, anæmia, and other diseases—cases which would benefit enormously from heliotherapy. We cannot send them to the

Alps and we cannot treat them by sunlight at home. What are we to do? *We can treat them by artificial sunlight.*

ARTIFICIAL HELIOTHERAPY.

The results obtained by artificial light are equally as good as those obtained by natural sunlight—so far as “light” itself is concerned. In natural heliotherapy the value of the pure air must not be lost sight of. We cannot obtain this in our towns and cities at present. But by the abolition of the smoke nuisance, the better housing and proper clothing of the people, and cleansing of their homes and bodies, and the provision of a sufficient supply of pure, fresh, unadulterated food, we shall, in time, attain near enough to this ideal.

Meantime, there is an urgent need for the establishment of light clinics in all our urban districts. Such clinics are needed in addition to the light departments of our larger hospitals. The author, some 18 months ago, started an experimental one, under municipal control, at Hull, with most encouraging results.

SOURCES OF ARTIFICIAL LIGHT.

The sources used must be such as yield a spectrum which is rich in luminous rays—particularly those at the violet end of the spectrum—and also in ultra-violet rays, for it is these latter which are of the greatest importance in the treatment of disease. The source should also be relatively weak in heat rays.

For practical purposes we have three such sources at our disposal. They all fulfil these conditions. Their richness in ultra-violet emanations has been demonstrated by: (1) spectroscopic examination; (2) power of killing infusoria; (3) their bleaching action upon the acetone-methylene-blue tubes of Dr. Leonard Hill. Ultra-violet light has the power of “bleaching.” A standard colour gauge enables one, by comparison of the tint, to judge of the ultra-violet content of any light, by exposing these tubes to the light for a known period and at a fixed distance, and comparing the resulting tint with the standard tint.

The sources at our disposal are: (1) The carbon-arc lamp; (2) the mercury-vapour lamp; (3) the tungsten-arc lamp. The two arc lamps are open—i.e., they are not enclosed in any way. The mercury-vapour lamp is enclosed and has a window of quartz. Ordinary glass does not permit ultra-violet rays to pass through it. Quartz, however, does.

Each of these lamps is made in various styles and patterns and each has its particular uses and advocates. Of the carbon-arc lamps, there are two chief patterns. The models of Reyn—Finsen’s successor at the Light Institute at Copenhagen—vary from 20 to 80 amperes in consumption, and require a voltage of 50 across the arc. Another type—varying from 20 to 50 in amperage—has a “flaming” arc and has been advocated by Dr. Leonard Hill and his co-worker, Dr. Eidinow, at

the National Institute for Medical Research, London. This “flaming” arc is produced by arranging the mechanism in such a way as to increase the voltage across the arc to anything from 60 to 80. The author is in complete agreement as to the superiority of these “flaming” arc lamps over the Reyn type, judged by clinical results.

One of these higher powered arc lights can treat six or more children sitting around. The children should be stripped to the waist—or naked, save for loin cloths—and wear blue-tinted or eosin-tinted goggles to protect the eyes. Such goggles must always be worn by operators and patients alike, otherwise a severe conjunctivitis might be produced. Instead of one powerful arc light, two or three smaller amperage ones may be used in series. A “direct current” is required and the voltage must be reduced by means of a suitable resistance, or a motor transformer used.

If the children are bed cases the arc light can be suspended above the beds. The patient should be about three feet distant from the source of light. The exposure time—ten minutes to begin with—is gradually increased, the front and back of the body being exposed in turn, until doses of from 1–2 hours, or even more, are given three or four times a week. Such high power carbon-arc lights are useful for institutions where a number of patients can be treated at one time. Once the current is turned on they burn without attention, being automatically adjusted. Plain carbon electrodes can be used, or electrodes “impregnated” by boiling in solution of salts of tungsten, molybdenum, &c. Some are “cored” with powdered tungsten. Dr Hill has advocated carbons cored with thin rods of solid aluminium. All these modifications in the electrodes are merely to enhance their ultra-violet emanations. By increasing the voltage and diminishing the amperage—thus raising the “potential” of the arc—the actinic power of the source is greatly increased.

The mercury-vapour lamp—which is in common use all over the continent—is made in several types. It has the advantage of consuming but a small amount of current. It is an enclosed arc formed by mercury vapour, which glows by the passage of the current and has a spectrum rich in ultra-violet rays, particularly those of shorter wave-lengths. It has a particular value in the treatment of local skin lesions. Its disadvantages are its extreme fragility, the wear of the “burners,” and the tendency for the mercury to become deposited on the quartz window after a time, thus interfering with the passage of the rays, as also by the alteration in the quartz itself as its life proceeds. Such a lamp is being used with success in the Infants Hospital at Westminster. Exposures of the trunk—back and front—are given for three minutes at first, gradually increasing in duration until a total exposure of even an hour may be given. The distance is varied—commencing at about three feet and gradually diminishing. Exposures are repeated two, three, or four times weekly.

ERYTHEMA.

After an exposure to any source we look for what is called a "reaction." Some few hours after an exposure—the time depending upon the factors of source, exposure, time, distance (the intensity of ultra-violet radiation is in inverse proportion to the square of the distance of the patient from the source of light), amperage, and personal idiosyncrasy—a reddening of the skin exposed to the rays occurs. This reddening is termed an "erythema," and is comparable to sunburn. It varies from a faint transient pinkness to a deep red colour, which may persist for several days. Speaking generally, blondes react more quickly and more intensely than do brunettes. The intensity varies with the individual and with the various factors enumerated above. This erythema is accompanied by more or less irritation, according to its intensity. It is followed by desquamation and afterwards by pigmentation. The degree of erythema and subsequent pigmentation obtained are regarded by many observers as a guide to prognosis. The author does not altogether so regard them. To obtain too rapid a pigmentation is to produce an immunity to further "provocative reactions." Each reaction, if a correct dose is given, is followed by a rise in the hæmo-bactericidal power of the blood, and, therefore, as the pigment is protective against reactions, its too speedy deposit is to be avoided. Those who "freckle" instead of turning brown, do not do so well. For "freckling" is not true pigmentation. But even a "freckler" may sometimes be persuaded to pigment, if the dosage is suitably modified.

Treatment should be given in large and well-ventilated rooms, and a period of rest of about half an hour after each treatment is an advantage. Exposures should not be repeated until the reaction of the previous one has disappeared. Otherwise, inflammation of the skin may result. The immediate effect of a correct exposure is a sense of well-being and stimulation. Fractious, ill-tempered, and restless infants and children become less nervous, more peaceable, happy, and contented. They sleep better, eat better, their digestion and power of absorption are improved, and metabolism in general is increased.

It has been conclusively demonstrated that ultra-violet radiation increases the amount of calcium, phosphorus, iron, and iodine in the blood, as well as the amount of hæmoglobin, and also actually increases the number of both red and white corpuscles. The internal secretory glands are stimulated. By the stimulation of the numerous nerve endings in the skin, responsive processes of a remedial character are set up, whose effects are felt by all the organs of the body. These facts will, in themselves, indicate a number of diseases which are amenable to this new form of therapy. Diseases due to an upset of the metabolic balance or to an upset of the vago-sympathetic balance are benefited often in a quite remarkable manner.

Amongst the diseases of infants and children which can be successfully treated are malnutrition, marasmus, rickets, anæmia, skin diseases, and surgical tuberculosis. Also functional, as well as some organic, nervous diseases, can be distinctly benefited. In adults such diseases as gout, "rheumatism"—fibrositis, neuritis, and the arthritic group—neurasthenia, high blood pressure, asthma, hay fever, goitre—including exophthalmic—skin diseases, are a few which can be named at random.

We are but on the threshold of this new method of therapy. Much research work is still required to be done both by laboratory and clinical workers. But enough is known already to make this new weapon in our fight against disease one of the most powerful in the whole medical armamentarium. It is an example of the "*vis medicatrix naturæ*."

In this brief address it has been impossible to do more than touch the fringe of the subject, but if I have succeeded in impressing my audience with the value of the method, its rationale, and its fascinating possibilities, then I shall have stimulated both their imagination and mental appetite, and I shall be content.

Reviews

SURGERY: A HUNDRED YEARS AGO.

Extracts from the Diary of Dr. C. B. TILANUS. Edited by H. T. DEELMAN, Professor of Pathology at the University of Groningen. Translated from the Dutch by JOSEPH BLES. London: Geoffrey Bles, Suffolk-street, Pall Mall. 1925. Pp. 156. 6s.

In the autumn of 1818 three young Dutch surgeons, C. B. Tilanus, J. C. Broers, and P. J. I. de Fremery, started on their post-graduate tour through France and Germany to see how surgery was practised at the chief universities. This book consists of extracts from the diary kept by Tilanus, who afterwards became the professor of surgery at the University of Amsterdam. Perhaps the reader will be most struck by three things. Firstly, the appalling mortality from surgical operations, almost all of it being due to post-operative pyæmia. Secondly, the frequency of venesection. Many a patient who had lost blood from an injury or operation was promptly bled or many leeches were applied. Thirdly, the same surgeon often looked after surgical wards filled with cases of pyæmia and after the maternity wards, so that there was a terrible mortality from puerperal septicæmia. These three young men fortunately had leisure, for they spent more than six months in Paris alone, chiefly with Dupuytren at the Hôtel Dieu and with Larrey at the Hôpital de la Garde. From Paris they passed to Strasburg, whence they walked to Tübingen. They give descriptions of the museums, which were very poor, and of the various medical buildings. There was a curious custom in the post-mortem room at Tübingen: "The corpse is, however, not finally abandoned, since, in order to guard against apparent death, strings are tied to the arms, which are connected with a bell in the inspector's room, so that he would be warned by the slightest movement." Next they journeyed to Stuttgart, Heidelberg, Frankfurt, and Giessen. At one place in Germany they gave the professor a tip of two thaler for showing them round; he accepted it without any resentment. These three post-graduates must have had a delightful walking tour; unfortunately, few can now afford to take things so leisurely. This translation gives an admirable account of the state of medical schools and learning a century ago, and we can strongly advise our readers to peruse it.