

along raphe; the fistulous tracks were dissected out. The halves of scrotum reunited (Fig. 5). The original fault in the urethral tube was found, cauterised, and a safety-valve gauze strip brought out from it on to perineum immediately opposite. Free internal urethrotomy was performed, and a catheter tied in for twenty-four hours. Sound healing in three weeks.

REMARKS.—I treat the original “faults” a little differently now, and I think more successfully. I dissect up, but do not open the last part of the tube until I feel I have reached a level with its opening into the urethra. The tube-funnel and the urethra now represent an open T-tube. I apply to the walls of the freed fistulous tunnel a powerful crushing pile forceps, and smash the tube flat, right up to the urethral wall, but of course taking care not to pinch the urethra. I then clip away most of it. By this means I not only close the false opening flush with the urethra, but I leave a solid undimpled new floor to the old orifice. Cases vary in their duration of convalescence. Some apparently do not unite by first intention, but the final result is the same; in healthy subjects they unite firmly. I prohibit cycling afterwards unless a special saddle is procured.

## THE HOT AIR TREATMENT OF DISEASE. ✓

By SAMUEL HYDE, M.D., *Buxton.*

IN the present day both patient and practitioner enjoy many advantages over our forefathers of one or more generations back, when a narrow and bigoted conservatism in therapeutics, as mischievous as it was unscientific, opposed nearly all new principles and practices in the treatment of disease, and, whilst refusing to make unprejudiced inquiry, branded as medical heretics all who resorted to new methods of treatment. Now, however, the old order of things has given place to one of general and universal investigation into the physiological and therapeutical action of all remedies, likely and unlikely, which hold out a prospect of benefiting various morbid conditions of the body. If there be cause at all for complaint nowadays, it will be found perhaps in an overweening and restless desire on the part of many to be constantly searching for some new remedy or method of treatment, whilst neglecting or misapplying the known and well-proved remedies already close to their hands. This mistake, which has long been known in the department of drug-treatment, is now a distinguishing characteristic with many practitioners at health resorts, the exigencies of whose practice demand the use of various methods of physical treatment of disease by baths, massage, electricity, etc. So strong is this temptation, sometimes, that many men are impelled on the most

extraordinary courses of action, thereby not seldom bringing scientific therapeutics into disrepute. What is required in the profession of medicine, and what I am glad to see is now taking place, is the patient and persistent investigation of the modes of operation of therapeutic agents, and the examination and fair trial of the various new or modified methods of treatment, which are from time to time presented to our notice.

A class of remedial agents, now claiming wide attention, embraces certain methods of the application of hot air locally to various parts of the body, and it has seemed to me that a useful purpose might be served by an article dealing with the general principles of treatment by high temperatures, and giving a comparative and detailed description of the most recent forms of apparatus for the application of thermal stimuli to the human body.

Before describing, however, the several methods and uses of hot air applied to the body locally, it is necessary to place before the reader a brief account of the physiological effects of high temperatures upon the animal organism, whether applied locally or generally.

THE PHYSIOLOGICAL ACTION OF THERMAL APPLICATIONS.—These effects are chiefly of the nature of thermal stimuli, and differ according to the form of application. It is also important to remember that the human body is more susceptible to the influence of such applications than are the bodies of lower animals, a difference due to the absence of a natural protective covering in the case of man. It is this susceptibility which is the cause of a special "reaction" always observed in some degree when water is applied to the human body at temperatures either above or below its own. These various applications operate as cutaneous stimuli, exerting primarily a vasomotor influence upon the capillary circulation of the surface of the body, and these are followed by local and distant reflex phenomena of the most striking and varied character.

It is customary to speak of "cold" and "heat" as though the terms related to two distinct forces or entities, whereas they refer merely to relative strengths or intensities of only one force, viz. caloric. In using the term "hot" in connection with the body, we mean an intensity of caloric in excess of its normal temperature. Now it is in this sense we speak of cold, warm, and hot baths, or other forms of thermal stimuli; and in discussing their physiological effects on the human organism, we must consider their effects upon—(1) the brain and nervous system; (2) the heart and circulation; (3) the respiration; (4) the temperature of the body; (5) secretion and excretion. Before doing so, however, I desire to say a few words about the thermal conductivity of animal tissues,—a subject of special interest in

connection with thermo-therapeutics, but one which has not received much attention at the hands of investigators.

It is chiefly due to the layer of fat beneath the skin that the heat of the human body is conserved and its conduction from internal organs is prevented. And as heat is thus prevented from being conducted out of the body, so the various degrees of caloric are in large measure prevented from entering into the body.

Griess has investigated the thermal conductivity of various animal tissues, such as the skin, bladder, hoof, horn, and bones of an ox, and the stomach of a sheep. By heating one part of the tissue and placing thereon pieces of wax, he came to the conclusion that fibrous tissues conducted heat more readily in the direction of their fibres than at right angles to their course. He arrived at this result by observing when and in which direction the pieces of wax commenced to melt. This opinion is supported by Landois, who found that tissues conduct heat best in the direction of their fibres. Next to bone, blood-clot is the best conductor. Bloodless skin is a bad conductor compared with skin containing vessels filled with blood, consequently the former gives off little heat, whilst the latter gives off freely and proves a good conductor of heat.

Now let us consider briefly the physiological effects of the hot bath, which, whether in the form of hot-water bath, vapour bath, or hot-air bath, exerts very powerful effects on the organism, and necessitates great care in its application. Its physiological action is almost entirely the reverse of the cold bath, and will be best explained, as before indicated, by a reference in turn to the effects produced upon the brain and nervous system, the heart and circulation, the respiration, the temperature of the body, and on secretion and excretion.

1. *On the brain and nervous system.*—Although the hot bath acts at first as an excitant, that is but transitory, and the general effect is that of a depressant. It produces a distinctly sedative influence on the sensory nerves, as is evidenced by the relief of painful parts by hot bathing. If the body be immersed for a long period in a hot bath, there is produced general nervous depression, languor, muscular weakness, drowsiness, and ultimately convulsions and coma may result.

The profound vaso-dilatation which affects the more superficial blood vessels of the body, causes a partial emptying of the deeper blood vessels and a slowing down of the circulation. As a result of this, the internal organs, including the brain and the spinal cord, become more or less anæmic.

2. *On the heart and circulation.*—Hot baths accelerate the heart's action, the frequency of its beat being in direct relation to the amount of vaso-dilatation of the superficial blood vessels. The effects on the general vascular system and circulation are

extremely marked. Redness and hyperæmia of the skin is produced, owing to dilatation of the superficial vessels. Dr. George Oliver has shown that hot immersion baths of 100° F. to 105° F. applied to the arm, quickly reduce the calibre and pressure of the radial artery, owing to the rapid dilatation which takes place in the arterioles and cutaneous periphery. This vaso-dilatation causes turgescence and swelling of superficial parts of the body, so that if the volume of a limb be measured immediately after the hot immersion, it will be found greatly increased; but this increment speedily subsides, and it therefore differs from the larger and more persistent increment of a limb induced by exercise.

3. *On respiration.*—The respiration is greatly accelerated as a first effect of hot baths, but the respiratory movements become slower if the bath is continued. Nevertheless increased respiration continues so long as the vaso-dilatation renders such respiratory aid necessary.

4. *On the temperature of the body.*—The effects of hot baths, like those of cold baths, on the temperature of the body are remarkable and interesting. The first effects are really cooling effects, and more heat is radiated from the body during the bathing process than under ordinary conditions. This is necessary, otherwise the temperature of the hot bath would increase the normal temperature of the body. To effect this compensation, the superficial vascular dilatation, with its increased secretion of sweat, and the accelerated respiration, with its increased excretion of the products of combustion and watery vapour, all contribute their share. It would also appear that the heat-producing mechanism of the body is slowed down so that the compensatory elimination of heat is rendered more easy and certain.

From experiments upon guinea-pigs, conducted by D. Finkler, it has been shown that the production of heat was more than doubled when the surrounding temperature was diminished 24° C. The metabolism of the guinea-pig is increased 23 per cent. in winter as compared with summer, thus showing the same relation to exist as in the case of a diminution of the surrounding temperature during a short period of time. From this we may assume that a converse action takes place when the body is immersed in a hot bath consisting either of water, vapour, or air.

5. *On secretion and excretion.*—The kidneys are stimulated to increased secretion, as also are the salivary glands sometimes. The sudorific glands become more active, and sweat is poured out in increased quantity. There is no very trustworthy evidence as to the physiological influence of hot baths on the secretion of the liver. According to Pflüger, when animals are placed in a hot bath at a higher temperature than that of their own bodies, the excretion of carbonic acid from the lungs is increased, owing to stimulation of their metabolism. There is also increased excretion

of watery vapour from the lungs, as we have already seen. With the augmented secretion of urine there is increased excretion of urea and uric acid. Hot baths increase the intestinal secretion, but lower the muscular tone of the bowels, and thus favour constipation.

I may here mention that partial hot bathing of one part of the body will sometimes produce a sweating effect upon another part. Thus one leg or one arm immersed in a bath of hot water, hot air, or hot vapour, not infrequently causes sweating of the corresponding limb.

Having thus briefly discussed the general physiological effects of the application of baths at high temperature on the body, the reader will be able to understand more clearly the action and effects of the local application of hot air to the human body in the treatment of various forms of disease. Before, however, discussing the clinical uses and effects of these forms of treatment, I propose to give a short description of the principal appliances which are now at the disposal of the profession.

**THE TALLERMAN APPARATUS.**—This method of applying superheated air to parts of the body was introduced to the profession in England about the year 1893, under the name of "The Sheffield Tallerman Treatment," and has been extensively used with considerable success in this country and abroad.

The apparatus consists essentially of a copper cylinder forming a chamber for the reception of a limb or part of a limb. This chamber is filled with dry superheated air, the source of heat being either gas, oil, or electricity, as may be most convenient for the purpose. The apparatus, although somewhat cumbersome, is portable, and can be conveyed to the patient's bedside. When gas is used for heating, it can be taken from an ordinary gas-fitting by attaching a flexible tube which supplies several gas jets under the cylinder. The proprietors have also arranged a system of electric heaters in connection with the apparatus, which are useful for heating the air where electricity is available. In country places where neither gas nor electricity is at hand, oil can be used as the source of heat. Modifications have now been made to the apparatus, by which hot dry air may be used internally as well as externally, and the hot air, at any desired temperature, medicated or otherwise, introduced either by inhalation or injection into the lungs or other internal cavities of the body.

The value of this apparatus is well established, and if it were possible to increase its portability and to relax the restrictive commercial conditions which have hitherto limited the area of its usefulness, there is no doubt that it would be used much more extensively than it now is. As it is, however, and notwithstanding that (like other similar modern methods of the local application of hot dry air) it is but a more practical and methodical system of

carrying out principles of local thermal treatment long known to the medical profession, I cannot withhold the well-merited praise which is due to Mr. Tallerman for having introduced to us a really efficient and valuable apparatus.

**THE DOWSING RADIANT HEAT BATH.**—This apparatus consists of an arrangement by which the heat produced by several powerful incandescent lamps, suspended within deeply recessed reflectors, is radiated or reflected on to any part of the body desired. The lamps or heaters, together with their reflectors, are mounted on stands which possess movable arms, by which they can be conveniently adjusted so as to more or less enclose the part of the body intended to be exposed to the powerful rays of heat generated from the lamps.

The advantages of this system of applying superheated air are very obvious. There are no possible means of contaminating the air of the room by products of combustion, there is no risk of fire, and it is easy to apply this radiant heat to parts of the body practically inaccessible to the Tallerman and similar apparatus. There is also less risk of producing burns on the surface of the patient's body which does not come in contact (even for rest) with any part of the apparatus itself, the enclosing reflectors being gradually approximated so as to enclose a sufficiently large space around the part, quite independently of the pillow or other rest supporting the same. The current of electricity for producing the radiant heat in this apparatus can be obtained from an electric light main by an ordinary movable attachment, and the temperature of this local hot-air bath may be graduated by means of a special regulator throughout a range of over 400° F.

A great drawback hitherto of this apparatus has been the difficulty of completely surrounding a part, say a limb, with the direct rays of heat; but this has now been overcome by the construction of suitable cylinders, which admirably meet the purpose. The more serious drawback is that of cost. Electricity is, as a rule, much more costly than gas or other common sources of heat, and in many places it is not obtainable at all, so that these considerations limit the usefulness of the system. Nevertheless, in simplicity, cleanliness, and safety, the Dowsing system has much to commend it, and, allowing for the drawbacks mentioned above, it possesses many advantages over similar apparatus.

**THE GREVILLE ELECTRO-THERMIC GENERATOR.**—An apparatus has recently been brought out, bearing the designation of the Greville Electro-Thermic Generator, possessing many features which recommend it for use as an efficient means of applying superheated air to the body in the treatment of many forms of disease. The thermal effects of electricity have long been made use of for the heating of stoves, ovens, and other useful appli-

ances, and the inventor of this apparatus has taken advantage of this principle, and by a simple and ingenious arrangement has produced his apparatus.

As in the case of the Tallerman system, the "Greville" appliances are mainly applicable to the upper and lower extremities of the body, and, subject to several modifications, they consist of a rectangular box or case made of aluminium and of an internal perforated metal cylinder. In the space between the internal cylinder and external case are stretched in numerous convolutions sections of electric wiring having a high resistance. The ends of the wires are attached to suitable terminals outside the generator. When it is desired to bring the latter into operation, it is only necessary to connect these terminals, by means of double wires, to an electric wall-plug, or to an ordinary electric light pendant, by using an adaptor in place of the usual incandescent lamp. This connection having been made, the current passes through the sections of thin wire in the generator, and, owing to the resistance met with, generates heat by which it is possible to raise the temperature of the interior of the cylinder to at least 400° F.

The wiring in the generator is arranged in separate sections, so that the attendant can vary and regulate the temperature inside the cylinder by switching on or off different sections of wire.

Mr. Greville has designed several kinds of generators suitable for the application of hot air, obtained upon the above principle, to the arm, shoulder, elbow, hand, leg, hip, knee, foot, spine, etc. To protect the parts of the body from coming into contact with the perforated metal lining of the cylinder, the generators are padded inside, and to prevent waste of heat, mackintosh sheeting lined with asbestos cloth is attached round the entrance of the cylinder, and this can be secured round the limb outside the generator by a bandage or other simple means. If it be desired to apply the hot air only to a middle joint, such as the knee or elbow, a short generator open at both ends, but having a double asbestos cloth arrangement, is used.

As in the case of the "Dowsing" apparatus, this system possesses advantages of simplicity and cleanliness which are more or less wanting in other hot-air arrangements, depending for their source of heat upon the combustion of gas or oil. One great objection, however, applies to this system as in the case of the "Dowsing," viz. the cost of an electrical source of heat, and the comparatively few institutions or dwellings where a supply of electricity is obtainable. Another disadvantage is the risk of the padding inside the generator becoming, after a time, fouled by the vapours exhaled from the parts subjected to high temperatures. This, however, is a matter which may be obviated by a frequent renewal of the lining material.

THE ELECTRO-THERMOGEN.—Dr. William Taylor of Edinburgh

has devised a very ingenious apparatus for the application of currents of hot air to local parts in neuralgia and other painful affections, which will prove a very useful addition to our present methods of local thermal treatment. The apparatus is small and portable, consisting of two parts—one of metal and the other glass. The former is a metallic chamber containing a fan and a clock-work or electro-motor, by which it is rapidly rotated to drive out the air from a small chamber above the fan through a rubber-lined orifice. Into this orifice is inserted the glass portion of the apparatus, consisting of two tubes, one inside the other, the outer one being prolonged downwards and inserted into the orifice of the air-chamber. Around the inner tube is wound in spiral form a fine wire connected with two terminals fixed in the outer tube, and to which are attached properly insulated wires for conducting a current of electricity from a convenient source to heat the spiral wire surrounding the inner tube. When the fan is set working it revolves at a rapid rate, driving a current of air through the tubes which is heated in transit, and as it emerges can be applied directly to any affected part of the body desired.

To provide a proper resistance, Dr. Taylor uses a lamp-holder midway between the adapter and the attachments to the tubes for the reception of two ordinary electric incandescent lamps.

To bring the apparatus into operation, it is only necessary to make the attachments to the two terminals of coiled wire and the four terminals of the lamp-holder, and then insert the adapter into the socket of an ordinary house electrolier, from which the lamp has been temporarily removed, when the lamps will immediately commence to glow. The clock-work, having been previously wound up, is started, and the fan being set to work, a current of hot air rushes from the tube, which can be delivered on a part at varying temperatures up to the highest possible degree bearable by the patient.

It is well known that still cold air can be borne at a lower temperature than moving air, and the same holds good in a reverse degree of hot air. For example, a steak requiring thirty-three minutes to cook in a temperature of 260° F., can be cooked at the same temperature in thirteen minutes if the hot air be blown upon it by means of a fan or bellows. In this connection Dr. Taylor points out that he has found, in treating neuralgia, currents of moderate temperature long continued are more effective than more intense currents of short duration.

By using a larger sized apparatus, this form of treatment is useful in cases of lumbago, sciatica, and painful affections involving large parts of the body.

**THERMAL AIR CHAMBER.**—An apparatus made from the designs and suggestions of Dr. R. Fortescue Fox of Strathpeffer, has been recently brought out. It is a most simple, portable, and useful

appliance for the local application of superheated dry air to the upper and lower extremities. It consists essentially of a wooden box, lined with asbestos cloth, the source of heat being a powerful spirit lamp situated underneath. The hot air passes into a double bottom of metal, entering the box through a fine wire meshwork, and is distributed throughout the chamber, afterwards leaving the box by openings which are graduated by sliding valves. With this apparatus it is possible to subject a limb to a temperature of 250 to 300° F.

I have now given the reader a description of the various methods of applying hot air locally in the treatment of disease, which are at the disposal of the profession. It will be observed, however, from what has been said, that none of these methods are absolutely perfect, and, whilst each apparatus possesses, it may be, some advantages which are lacking in the others, all, without exception, possess in greater or lesser degree an element of risk rendering extreme care necessary on the part of the attendant to prevent severe burns of the patient's person. But this is perhaps inevitable in the construction of any really efficient local hot air apparatus.

*Advantages of treatment by heat locally.*—It cannot be denied that the recent tendency in favour of local methods of thermal treatment, in lieu of general methods, in which the whole body is exposed to a large volume of hot air or vapour, has been productive of good. After an experience of nearly a quarter of a century of bath treatment, and practical observation of the effects of higher thermal appliances, no conviction has become more deeply rooted in my mind than this, viz. that great and lasting injury is frequently incurred by patients suffering from certain varieties of disease, in consequence of the improper or excessive use of Turkish, Russian, and other hot baths. Cases are constantly coming under my observation, particularly of rheumatoid arthritis, which, either on their own initiative or the mistaken advice of their medical attendants, have taken prolonged and repeated courses of Turkish or similar baths with disastrous results. My case-books abound with notes of such patients, and I feel that I cannot too strongly condemn the free use of general hot baths of any kind in diseases associated with lowered nervous tone and depraved nutrition. And here I would warn the reader against the danger of being deceived by the apparently great benefit which so often results at first from the use of such baths in these cases. These results are often really marvellous to the casual and inexperienced observer, but, alas! they form in too many instances only transitory and delusive periods of relief precursory of an aggravated state of the disease, which is the direct result of the over-stimulating effects of this higher thermal treatment.

Upon this subject I may be permitted to speak with some

emphasis, as in my earlier writings I was perhaps the first practitioner to call the attention of the profession to this important subject. Since then it has afforded me satisfaction to receive recognition of these views in the medical press, and also from numerous members of the profession resident in this country and abroad.

Upon this question I regret that I cannot agree with Dr. Douglas Kerr and Dr. W. S. Hedley, that in using the hot air bath, the more extensive the surface of the body to which the heat is applied, the better the results. These gentlemen recommend, as a rule, the use of the "full bath," excluding the head, in preference to purely local applications. Now, whilst I will not deny the great benefit obtained by the full bath in many affections in which free diaphoresis and more general effects are desired, I contend that it is in the easy adaptability of these new hot air appliances to local parts, as in joint affections, sciatica, lumbago, etc., that their chief and peculiar value lies. Otherwise the Turkish or hot air box-bath would serve our purpose equally well. Our object, especially in chronic joint affections, should be to produce the greatest possible local effects with the least possible general disturbance. Not that we can ever hope to benefit chronic rheumatoid joint affections by any form of local treatment, without at the same time using measures for restoring the general health, but these general measures must lie more in the direction of pure air, exercise, diet, and baths of lower thermal activity, and more tonic influence than the hot air applications to the joints.

Holding as I do the opinions just expressed on the frequent pernicious effects of general hot baths, I am the more prepared to recognise the advantages which local hot air baths often possess in the treatment of disease in which general hot air or vapour baths are contra-indicated. In chronic joint affections of rheumatic or gouty origin, in lumbago, sciatica, and similar painful nerve affections, local hot-air baths form one of the most valuable adjuncts of modern therapeutics. Also in certain skin diseases, in some acute and chronic kidney and liver affections, and in other diseased conditions which will occur to the reader, great benefit can be derived from their judicious and careful use.

There has been much discussion on the therapeutic advantages of luminous rays of heat over non-luminous heat rays, and it has been claimed for the Dowsing apparatus that greater benefit may be expected from its use, on account of the penetrating quality of the heat rays than from the dark heat of the Greville apparatus. It is true that rays of sunlight and also electric light exert powerful effects not only upon the skin, as has been pointed out by Dr. Bowles, but also upon the circulation and other nutritive processes, but our knowledge upon the subject is so meagre that we may for the present assume that the heat, if dry and of sufficiently high temperature, is of equal therapeutic value,

whether derived from a luminous or non-luminous source. Personally, I have observed excellent results in stiffened and painful joints, sciatica, lumbago, etc., by the employment of the various forms of local hot air baths, whether with luminous or non-luminous heat.

So far as the local effects of this treatment are concerned, the benefit is not difficult of explanation. As we have seen, the effects on the circulation in the tissues exposed to the influence of the hot dry air are very marked. There is increased circulation *in* the parts and *to* the parts, so that the process of tissue metabolism is stimulated, and changes of a recuperative character are encouraged.

Thus far, I have referred mainly to the usefulness of the hot dry-air bath in the treatment of certain local joint and painful nerve affections. There are, however, numerous other diseased conditions in which its judicious use is beneficial.

Dr. Knowsley Sibley and others have used the treatment with some success in chorea and epilepsy. Locomotor ataxy is also said by some to be benefited. In my experience, however, higher thermal treatment in any form is not only useless, but seems to be often injurious, in most of these cases of central nervous disease. Nor can I bear out the testimony of some as to the benefit of hot dry-air treatment in chronic bronchitis or cardiac affections, except when associated with renal disease. In such cases, however, the ordinary box vapour bath is more useful. In many pelvic troubles of women the bath is often of great service. Skin diseases of various kinds are also frequently amenable to this form of treatment after other measures have failed.

In concluding this cursory and necessarily imperfect résumé of a subject which is at the present time exciting considerable attention in the profession, I venture to hope that I have given the reader a fairly clear idea of the principles which underlie this special form of treatment, and that, in describing the various appliances for its administration, I have given an impartial account of their merits or demerits without fear or favour. Whilst it is only an act of justice to acknowledge the valuable services which have been rendered to the profession by Messrs. Tallerman, Dowsing, Greville, and others, in designing and producing the several forms of hot air apparatus now available, I cannot refrain from the expression of a hope that these gentlemen may see their way to relax and modify the commercial conditions which have hitherto acted as serious drawbacks to the extended usefulness of their appliances.

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