orthophoric on the wing test, should have no hyperphoria, and should have well-developed stereopsis and a corrected visual acuity of 6/6. Failing this, the subject should be monocular for near vision.

On the psychological side it cannot be claimed that testing is necessary for the selection of workers for this particular department, since the management, from long experience, only tries girls whom it has good reason to think will prove suitable. Those who show fatigue during the training period are not retained. We are not in a position to generalize as to what type of human being is best suited for this work, but, on the evidence of this one test, we might say that, although a few neurotics may be able to do it, the safest group are the good average people who are not unduly blessed with imagination nor are highly intelligent—a statement which probably holds true for any repetitive factory process. If, therefore, selection tests in industry were contemplated, the factors on which judgment of fitness for close work should be based would appear to be, in order of importance: (1) binocular balance; (2) refraction; (3) psychological stability.

It would seem likely to be of advantage, in industrial and other processes such as that described, to test the candidate with these points in mind before starting training, which otherwise may only prove to be a waste of time.

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THE ACTION OF ELECTRIC BLANKETS

BY

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In a previous communication (Brown, Evans, and Mendelssohn, 1943) the action of radiant-heat cradles was recorded. Continuing this work on heating apparatus in clinical use, we have carried out an investigation on the action of electric blankets. These two methods of supplying heat to the body differ very much in their physical aspects, for the cradle acts mainly by heat radiation,† whereas heat from the electric blanket is conveyed to the patient almost exclusively by conduction. It seemed of interest, therefore, not only to observe the action of the electric blanket in clinical use, but also to compare the effects of both methods on the same patients under similar conditions. The difference in physical action between the two methods naturally entails certain differences in efficiency, applicability, and supervision, and one of the objects of this investigation was to decide which method could be used most advantageously for different purposes.

The electric blanket which we used had been supplied by Thermega, Ltd. It is a large heating pad of the ordinary type, measuring 33 by 46 in. Heat is generated by a current (mains supply) passing through a resistance element. The maximum temperature of the electric system is limited by thermostatic control of the current supply. The average consumption was found to be about 120 watts, and varied but little with the temperature of the heating element. The current passing through the blanket was 0.511 amp. at the outset, 0.512 amp. after 1 hour, and 0.517 amp. after 4 hours. The total amount of heat produced by the blanket is therefore about 100 calories per hour.

* In receipt of a personal grant from the Medical Research Council.

† As has been emphasized before (Brown, Evans, and Mendelssohn, 1943), heat conduction and convection through the air inside a cradle also play an important part in conveying heat to the patient, but it is not known how large this part actually is.

The temperature of the heating element proper must be kept low for reasons of safety. Since the material between the actual heating wire and the skin of the patient is probably opaque for far infra-red radiation—the only radiation which the heater emits—it appears reasonable to assume that practically all the heat taken up by the patient is by conduction.

Physiological Action

The method of clinical use of the electric blanket consists in putting the blanket on the bed, covering it with an ordinary woollen blanket, and placing the patient on top of this. For reasons which we shall discuss later, the method of covering the patient has a very considerable influence on the rise in body temperature. In our case one woollen blanket was used and the patients were allowed to put their arms on top of the cover. By placing a thermometer on the bed in the position to be occupied by the patient it had been found that temperature equilibrium was attained only after about two hours (Fig. 1). We therefore heated the blanket for at least two hours before the patient was placed on it.

FIG. 1.—Curve showing the temperatures recorded by a thermometer placed in the position of the patient above the electric blanket.

The tests were carried out on volunteers, who were submitted to heat treatment with the blanket for periods ranging from 1½ to 2 hours. The body temperature was determined in some cases orally, using an ordinary clinical thermometer, and in others with an electric recording rectal thermometer. One characteristic temperature/time curve showing the results with the electric blanket and the radiant-heat cradle is reproduced in Fig. 2. Both these curves show that the first reaction to

FIG. 2.—The body temperature of a subject heated first with the electric blanket and later with the radiant-heat cradle.

the application of heat is a *decrease* in body temperature. This peculiar phenomenon had already been observed in 9 out of 12 experiments with the radiant-heat cradle. Of the 7 cases

investigated with the blanket, 5 showed this initial temperature decrease. It therefore appears that the phenomenon is quite generally a result of heat application and is not confined to heating by radiation. It was noted, however, that, whereas the temperature drop in the cradles occurred at 5 to 20 minutes after the beginning of treatment, it occurred with the blanket only at 30 to 90 minutes after heat was first applied.

The average rise in body temperature which we observed when using the blanket was about 0.45° F. per hour (see accompanying Table). This is much less than has been reported

Table showing the Rise in Body Temperatures, the Heat apparently taken up by the Subject, and the Heat generated by the Apparatus in 14 Experiments

Case No.: Sex:	1 M	2 M	3 F	4 M	5 M	6 F	7 F
Time (min.)	120	120	120	90	90	105	90
ΔT (° F.)	1.7	0.5	1.1	0.4	0.6	0.6	0.7
Q (cal.)	63	20	35	15	23	17	18
P (cal.)	200	200	200	150	150	175	150
ΔT (° F.)	2.1	1.0	1.6	2.5	0.8	0.8	0.8
Q (cal.)	78	40	51	93	31	22	21
P (cal.)	970	1,300	970	780	780	875	750

ΔT : Rise in body temperature. Q : Heat apparently taken up. P : Heat generated by the apparatus when the subject was treated with the electric blanket. ΔT , Q , P : The corresponding figures when the subject was treated with the radiant-heat cradle.

by others. Neymann and Osborne (1934), for instance, find an hourly rate of rise of 1.1° F. in rectal and 1.8° F. in axillary temperature for the first two hours of application. This discrepancy can probably be explained by the method of covering the patient. If the electric blanket is wrapped around the body and the arms are kept in, the rate of temperature rise is bound to be greater. In fact, as Epstein and Cohen (1935) have reported, a rise in body temperature of 1.6° F. to 1.8° F. per hour can be produced without the use of any heating equipment simply by wrapping the patient tightly in a number of blankets and a rubber and a canvas sheet.

At first sight it seems astonishing that, merely by preventing the loss of metabolic heat, increases in body temperature occur which are about as high as those obtained with quite powerful external heating methods. An explanation for this can be found by comparing the amount of heat actually taken up by the patient from the external heat source with his own metabolic heat production. In the Table the total heat (P) supplied in our tests by the blanket, and the heat (Q) apparently taken up by the patient, are given. This amount of heat "apparently taken up" represents, however, not necessarily the real amount of heat received by the patient, since the calculation does not take account of any change in the rate of loss of heat by the patient through physiological processes. The total heat generated by the blanket (100 cal./hour) is of the same order as the metabolic heat itself. Only 15% ($\frac{Q}{P}$) of this heat supply, however, is apparently taken up by the patient. It is therefore not very surprising that an arrangement which prevents the loss of part of the metabolic heat will heat the patient as quickly as an electric blanket, which, after all, delivers to the patient approximately only the heat which he normally generates himself.

Comparison of the Electric Blanket with the Radiant-heat Cradle

The same 7 volunteers were subjected to heat treatment of equal length with the shielded cradle described by us in our earlier paper. The results are given in the Table. As can be seen in Fig. 3, the cradle heats about twice as much as the blanket. The method of treatment with the cradle was that previously recommended by us. Twelve bulbs were used at first, and the number was reduced to 8 bulbs after 20 to 30 minutes. The average rate of temperature rise observed in the present research was 0.8° F. per hour. Considering the scatter, this result is in remarkable agreement with our previous work, when we found the rise to be 1° F. per hour. A slightly lower value was to be expected in the present tests, since in the first investigation 12 bulbs had been used throughout. The temperature rise produced with the blanket was about the same as that observed with the unshielded cradle used in the orthodox way.

Fig. 3.—The rises in body temperature observed in 7 subjects treated with the electric blanket and the radiant-heat cradle.

While it is true that the shielded cradle supplied nearly twice as much heat to the patient as the blanket, it is less economical, because it produces five times as much heat at the source ($\frac{P}{P'}$). The heat taken up by the patient is only about 5% of the total heat generated ($\frac{Q}{P'}$). As the difference in the cost of electricity can in most cases be neglected, the cradle's lack in economy is not very serious.

Thinking, however, in terms of absolute quantities of heat taken up by the patient, the low efficiency of the cradle compared with the blanket requires some explanation, since the total amount of heat generated by the former is about five times the metabolic heat. It appears to us that the two main factors which lower the efficiency of the cradle are heat loss to the outside and heat loss from the patient by perspiration. With the blanket, on the other hand, both these factors are reduced to a minimum, since there is less heat loss from the heating element, which is placed between the bed and the patient, and since the covering blanket contains practically no space for the evaporation of sweat. Experiments to improve still further the efficiency of the cradle are in progress.

Discussion

The electric blanket has advantages which recommend it for certain clinical uses. It is safe and causes no discomfort at ordinary heating rates. When used to produce artificial hyperpyrexia there have been cases of fire due to a fault in the heating element, but we know of nothing similar occurring in ordinary use. It requires little supervision. None of our volunteers complained of any skin discomfort, and the risk of burns is less than with an unshielded cradle. The shape and the position in the bed are but a small inconvenience to the nursing staff. A most important disadvantage, however, is the long period taken to reach the maximum temperature and the lack of variability of control. With the cradle it is possible to raise the temperature of the air around the patient's body very quickly to a given degree and to maintain it at that level for an indefinite time. Even at its maximum temperature the electric

blanket raises the body temperature only half as quickly as the cradle. The cradle is the better instrument when heat is required quickly and in large quantities. When forethought is possible and less heat is required the blanket is to be preferred. To warm the waiting bed for the patient or to keep him warm out of doors in cold weather the blanket should be used, but when heat is prescribed for the victim of an accident the heat cradle is indicated.

The administration of heat presents several problems, aside altogether from the question of its therapeutic value, which we do not wish to discuss. For instance, we are at a loss to explain the decrease in body temperature which occurred in the first period of treatment in a great majority of our cases. At the same time the skin temperature was rising rapidly to its final value. This effect of an artificially increased skin temperature on the body temperature needs more investigation. We must also keep in mind that the physiological reaction in local application is probably quite different from that in general application of heat. The same dose of radiated or conducted heat may result in a very different response, depending upon its localization. It should be clear what is needed when heat is prescribed—an increase in body temperature or merely the application of warmth to the skin. Each requires its own mode of application. A hot-water bottle is an easy way to warm the skin, and in many cases that is all that is indicated. However, 500 c.cm. of water cooling through 50° C. does not make an important contribution to body heat, and where this must be increased the shielded cradle is the instrument of choice. It is clear from our observations that in the healthy volunteer under treatment the rate of heat loss is greatly increased. His skin is flushed and soon covered with perspiration. The effects on the temperature-control mechanism in the cold shocked patient may not be the same. A completely rational therapy will have to wait on a further knowledge of the relation of all these factors.

Summary

The electric blanket acts by conduction of heat to the patient. Even when the bed is warmed beforehand it is only half as quick as the radiant-heat cradle in raising the body temperature. On the other hand, it occupies little space and is almost foolproof.

Our thanks are due to Prof. L. J. Witts for his continued interest in this work.

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ACUTE NICOTINIC ACID DEFICIENCY (ANIACINOSIS)

BY

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General physicians are occasionally confronted with cases of mental confusion or stupor in middle-aged or elderly persons for which no obvious cause is found. A provisional diagnosis of uraemia, arteriosclerotic dementia, or cerebral vascular accident is made and sedatives are administered. Some cases are transferred to mental observation wards. Death usually occurs in a few days as a result of bronchopneumonia, and post-mortem examination may show no cause for their mental state. I believe that an appreciable number of lives could be saved if nicotinic acid (niacin) therapy was instituted rapidly in these patients. The following is a brief description of five such cases.

Case I

A woman aged 56 was admitted to Highgate Hospital (L.C.C.) on March 7, 1942, in alcoholic coma. She was cyanosed, with the pulse imperceptible. Following warmth, oxygen, and 4 c.cm. of nikethamide (diethyl nicotinamide) she revived. On March 8 she was quite well, apart from some amnesia for recent events. On the 10th she became confused, restless, and irrational, and declined all her food. Her confusion gradually became worse, and on the 11th she was completely disorientated as to time and space, wandering about the ward and talking loudly. Transfer to the mental observa-

tion ward had to be considered. Apart from nystagmus no physical abnormality was noted. 100 mg. of sodium nicotinate and 25 mg. of thiamin were given intravenously. A few hours later she was quieter and less confused. Subsequently she was given daily 200 mg. of sodium nicotinate intravenously, 100 mg. of nicotinic acid orally, and 25 mg. of thiamin. After a total dosage of 400 mg. of nicotinic acid in 28 hours she was greatly improved. She was well orientated as to time and space, and quiet and co-operative, remaining so until her discharge on April 2, 1942. Two months later, when seen as an out-patient, she had no recurrence of mental symptoms and was perfectly well. She was a heavy drinker, mostly of beer, and her diet consisted mainly of white bread, butter, and tea, and some boiled vegetables. She hardly tasted meat. Her gastric juice showed complete achlorhydria. Her blood W.R. was negative. Electrocardiograms revealed left ventricular preponderance but no other abnormality.

Case II

This patient, a woman aged 76, was admitted to St. Alfege's Hospital on March 12, 1943, in a state of mental confusion, disorientation, restlessness, and frothing at the mouth. She was incontinent of urine and faeces. The mental symptoms had developed gradually during the past week. She was markedly anaemic, with petechiae and purpura over the whole body and large bruises on both legs. The blood count showed R.B.C. 1,000,000, C.I. 1.4, granulocytes 2,100. Her diet had consisted almost entirely of bread, margarine, and tea for the past few months. She was almost totally blind owing to bilateral cataracts, and her aged husband was a chronic invalid, hence the difficulty of obtaining a suitable diet. She was considered to be suffering from nicotinic acid deficiency, scurvy, and pernicious anaemia. As she was seriously ill, nicotinic acid, ascorbic acid, and liver injections were immediately given. Following 300 mg. of nicotinic acid by mouth in 24 hours her mental state had improved dramatically. She was conscious, rational, and co-operative, and the control of her sphincters was satisfactory. She was still disorientated as to time. After a total dosage of 600 mg. of nicotinic acid by mouth in 48 hours she was mentally clear, and remained so until her discharge from hospital on May 17. The petechiae and bruises disappeared within a week, after 1,500 mg. of ascorbic acid injections had been given. The anaemia responded satisfactorily to liver therapy.

Case III

A man aged 46, a publican and a heavy drinker of rum and beer, was admitted to St. Alfege's Hospital on June 7, 1943, with ischio-rectal abscess. He was mentally normal on admission. Owing to chronic alcoholism his diet had always been erratic. Four years previously he had had a sore tongue, with cracks which took many months to heal. Since June 2, when the abscess developed, he had had almost no food apart from alcohol. On June 7 the abscess was incised under spinal anaesthesia. Twelve hours after the operation he became delusional and hallucinated, but had insight into his confusion. He was worse at night, when he was noisy and disturbed the other patients. Transfer to the mental observation ward was considered. When seen by me on June 10 he was confused and completely disorientated to time, but was aware of his confusion. His mouth and tongue were fiery red and dry, but no other physical abnormality was noted. Although he was subsequently unaware of this examination he was able some days later to give a vivid description of his delusions and hallucinations. After a total dosage of 600 mg. of nicotinic acid by mouth in 36 hours his mental state, as well as his tongue, became normal, and remained so until his discharge from hospital on June 21. When seen one month later as an out-patient he was perfectly well. The gastric juice showed hypochlorhydria. The blood W.R. was negative and the blood urea normal.

Case IV

A woman aged 62 was admitted to St. Alfege's on Sept. 16, 1943, in a state of mental confusion and disorientation. She had always been a small eater, and, according to her husband, "picked at her food like a baby." Since the death of her son a year ago her appetite had become even worse; but, apart from chronic constipation, her general health remained fairly good. Following some mental shock a month before admission, she became listless and could only be persuaded to take bread soaked in milk. There was no history of alcoholism. The angles of her lips became cracked three months previously. Her memory began to fail two weeks before admission and she was confused and disorientated, with incontinence of urine. Her tongue was sore for 10 days. Her symptoms grew progressively worse. She was given orally 90 mg. of thiamin and 150 mg. of nicotinic acid daily from the time of her admission until Sept. 27, without improvement.

When I first saw her on Sept. 27 she was confused and disorientated to time and space. She was incontinent of urine, and her memory, especially for recent events, was grossly impaired. She was a small thin woman, with an inelastic and dehydrated skin. Her nose was red and the backs of her hands were smooth and