THE TREATMENT OF GONORRHOEAL ARTHRITIS

BY ARTIFICIAL FEVER.

by

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INTRODUCTION.

Since the days of Hippocrates fever has been a major concern of physicians. Originally and for a long time it was regarded as a defensive mechanism against disease. Then, following the work of Claude Bernard, Virchow and others, who demonstrated supposedly harmful physiological and pathological reactions to fever, came the era of antipyresis by medical and physical means.

That fever, however, must serve some useful purpose, or nature would not have clung to it so tenaciously as a reactive process to the invasion of harmful noxa was later still the view of Welsh and others, and during the last four decades opinion has veered in favour of the view that fever has a beneficial purpose. Consequently the idea of the necessity for the combating of fever as a harmful condition by means of hydrotherapeutic applications or by antipyretic drugs has gradually been replaced by the realisation that the body increases its defence activities with the raising of systemic temperatures.

The current development of fever therapy is an indication of the wide acceptance of this view. Under certain conditions and within certain limits, hyperthermia is a state not to be prevented, but to be fostered.

Many/
Many old and new methods are being advocated for fever therapy. Since the sixteenth century curative effects in syphilis and in various forms of rheumatism have been ascribed to frequent bathing in hot volcanic water. The temperature of the water being from 113 to 128°F., it has been estimated that fevers of from 103 to 105°F. were produced thereby. (Neymann & Osborne, 1934).

It is customary to regard febrile reactions produced by the injection of foreign protein as the modern forerunner of fever therapy. The use of dead organisms (Bacillus coli or typhosus) was the next logical step, and this was eventually surpassed by Wagner-Jauregg's success with malarial therapy in neurosyphilis.

While certain definite results have been obtained, these various methods have the disadvantage that their reactions, once initiated, are not always entirely controllable. Hence the modern view favours a return to the physical, in place of the bacterial, methods of producing fever.

Steps in the development of pyretotherapy by physical means include the use of hot baths by Philips, (1884), Mehrten and Poupit (1929), of hot air by Rosanoff (1927), of high frequency diathermy currents by Neyman and Osborne (1929), of radiothermy by Carpenter and Page (1930), of humidified, electrically/
electrically heated cabinets by Simpson, Kislig and Sittler (1933).

Physically produced fever in the treatment of gonorrhoeal arthritis is not to be regarded as just another method of treatment to be added to the countless ones in which all physicians have been disappointed, for the results described, can be, and are being duplicated by others.

This method of treatment has been the subject of an increasing number of reports in medical literature during the past few years. Most of the reports have come from the United States of America and the large majority have described results which are satisfactory and often remarkable.

The reports indicate that good results are obtained by a number of different types of apparatus, and it appears to be generally accepted that the method of raising the temperature is not of primary importance provided that due regard is paid to the safety and comfort of the patient. The newer types of fever cabinets allow a degree of accuracy of control, for both height and duration of pyrexia, which was previously difficult to obtain and which contributes largely to the successful results.

The particular type of apparatus used by the writer is the Inductotherm Fever Cabinet and the treatment is known as "Inductopyrexia".
RATIONALE OF FEVER THERAPY.

The development of this method of treatment in gonorrhoea and its complications was largely the result of observations by many clinicians, who found that during an acute febrile illness a concurrent gonorrhoeal infection would either temporarily or entirely disappear.

Guiard (1894) observed a patient with gonococcal urethritis who was apparently cured after an attack of scarlet fever. Steinschneider and Schaffer (1895) noted that a temperature of 104° to 105.8°F was supposed to kill the gonococcus. Nobl (1901) however noted that fever at low levels from intercurrent infections did not cure gonorrhoea. Luys (1917) records a case in which the urethral discharge disappeared during the febrile stage of an attack of mumps only to return after the subsidence of the fever. Frazer and Duncan (1920) observed that patients with gonorrhoeal arthritis during an epidemic of influenza were clinically much improved.

As a result of those and other observations many of the clinicians who were treating gonorrhoea formed the impression that a major portion of the beneficial therapeutic effect was due to direct action of heat on the organisms and therefore experiments dealing with/
with the effect of heat on the gonococcus were commenced. Carpenter et al (1933) showed that a temperature of 105.8°F. for four to five hours will destroy 99 per cent. of free gonococci; the remaining 1 per cent. require 11 to 23 hours exposure. At a temperature of 106.7°F. 99 per cent. of the gonococci were rendered non viable in 2 hours. Kendall, Webb & Simpson (1935) have repeated the experiments of Carpenter, Boak, Mucci and Warren with essentially identical results.

From these studies it became apparent that it would be possible to exceed the thermal death point of the organism without injury to the human host and these observations provided the impetus for a trial of hyperpyrexia in the treatment of gonococcal infections.

Boak, Carpenter and Warren (1935) reporting on 11 patients with gonorrhoea who were given a single fever treatment of 106.5°F. maintained for a time equal to the thermal death time of their particular strain of gonococcus, noted immediate subsidence of all symptoms and had a bacteriological cure. The fact that similar results were noted in 9 other patients with fever treatment of from one-fourth to three-fourths of the thermal death time suggests that bodily mechanisms of defence are called into action to/
to produce a cure.

While it would seem logical to adapt the treatment of each patient to the thermal death point of the strain of gonococcus producing his disease, there are important objections to such a plan. Of these objections, two only require to be mentioned. Firstly, it would require elaborate laboratory facilities and experienced technicians, to establish the thermal death point, and, secondly, it might be impossible to recover the gonococcus at the time when the patient came for treatment.

Apart from the direct lethal effect of a high temperature on the gonococcus there is also experimental evidence to show that high temperatures exert a bacteriostatic effect on the gonococcus, and also that stimulation of the defence mechanisms of the body is responsible in part for the results achieved by fever therapy.

Reimann (1932) reports an increase in the agglutinins during hyperpyrexia. Bierman and Fishberg, (1934) observed a reduction in the complement fixing titre in the serum of individuals suffering from gonorrhoea (with positive complement fixation in the blood serum) as a result of the administration of hyperpyrexia. Jung and Day (1931) found no change observable in the opsonic index in hyperpyrexia. Warren and Wilson (1932) state that leucocyte count/
count shows an initial fall, followed by a subsequent rise to 15,000 per cubic millimetre, and that there is also an increased rate of phagocytosis.

Bierman and Fishberg (1934) found an initial reduction in the number of leucocytes up to 30 per cent, occurring during the first two hours of hyperpyrexia. Thereafter a constant leucocytosis occurs, the maximum of which, amounting to about 80 per cent. above the initial figure, occurs from the sixth to ninth hour. These changes are mainly due to an increase in the number of neutrophils together with the appearance of immature forms, and indicate a stimulation of the bone marrow.

The benefits of fever therapy presumably arise from:

(1) a direct bacteriolytic or bacteriostatic effect due to the influence of heat itself on bacteria;

(2) an indirect bacteriolytic or bacteriostatic effect resulting from increasing the formation of, or mobilisation of, immune bodies;

(3) a local effect from vasodilatation providing an augmented blood supply to inflamed tissues.

(4) a general effect from the heightened metabolism incident to fever.

A patient with arthritis may be helped by any one of these factors acting alone or in combination.
In the treatment of gonorrhoeal arthritis it has been found that four to six treatments each of four hours duration at a temperature range of 105.6°F. to 106°F. are productive of prompt and satisfactory results. Four treatments at intervals of three to five days, the interval depending upon the general condition of the patient and his endurance, are regarded as a minimal course.
PHYSIOLOGICAL REACTIONS TO FEVER THERAPY.

Hyperthermia, regardless of the method used, is characterised by more or less identical physiological effects. Only those effects which are of value in assessing a patient's condition, during treatment require consideration here.

Cardiac function and blood pressure.

The natural reaction of the body under the conditions of artificially induced fever is to maintain its temperature at normal. Accordingly, if the heat regulating mechanism functions normally a great effort is made to dissipate the accumulating heat by evaporation. Blood must be circulated with increasing rapidity through the two great surfaces where such evaporation may take place; namely, the pulmonary circulation and the peripheral capillary bed in the skin. As nature loses the fight to keep the body temperature normal, the pulse rate increases and the systolic blood pressure falls.

The pulse rate varies in inductopyrexia according to the body temperature in a manner similar to that in fever, with an increase of from 6 to 11 beats a minute for each degree above normal (98.6°F.) The pulse rate during a treatment ranges between 120 and 140 per minute. The rate varies somewhat with the state/
state of rest or excitement displayed by the patient from time to time, but a pulse rate of over 160 is regarded as an indication to terminate the treatment.

Blood pressure readings show a rise, most marked during the temperature climb and gradually receding as the temperature is maintained, until finally at the close of treatment the pressure is somewhat less than normal.

A study of the colour of the patient's face is a good index of his condition. A pallor of the face, beginning round the mouth, accompanied by enophthalmus is a warning sign of failing peripheral circulation, and will be followed by a drop in the systolic and diastolic pressure.

Circulatory collapse is more liable to occur in the later hours of treatment at a high temperature level. This is the reason for hesitancy in exposing patients to a longer duration of fever than four hours.

The foregoing observations indicate that a fever treatment is an exhausting procedure for the patient, particularly if repeated frequently, and one which can only be recommended to those in robust health.

It is therefore obvious that there should be no gross cardiac, renal or pulmonary condition present which would contra-indicate treatment. In attempting to assess how the patient will tolerate a fever treatment/
treatment, a simple comparison might be drawn by enquiring as to how the patient would tolerate a prolonged general anaesthetic.

A general clinical examination is therefore made on the usual lines and this is supplemented by the following laboratory examinations:

(a) X-ray of lungs, heart and aorta;
(b) electrocardiogram;
(c) estimation of blood urea.

In none of the present series of cases was any fact discovered which contra-indicated treatment with Inductopyrexia.
THE INDUCTOTHERM FEVER CABINET.

Artificial pyrexia induced by the Inductotherm Cabinet combines the principles of electromagnetic induction for the elevation of temperature with an air-conditioned cabinet for maintaining the temperature.

The Inductotherm is a vacuum tube oscillator generating an alternating current with a frequency of approximately 12,000,000 cycles per second. The current is conducted through a heavily insulated cable wound in a single elliptical coil 12 inches wide and 4 feet 9 inches long. The cable is built into a horizontal mattress board in the cabinet, over which a rubber sponge mattress is placed, and on which the patient lies.

Within the coil through which the current flows, there is set up an alternating magnetic flux having the same frequency as the current in the coil. If a conductive material is placed within the coil an electromotive force will be induced in it. As a result of this induced voltage eddy currents of the same frequency as the existing current will flow in the conductive material.

If living tissue is subjected to the magnetic field of the Inductotherm there will be no neuromuscular response to the eddy currents induced in the tissues because the frequency of the currents is very/
very high - 12,000,000 cycles per second which is far above the frequencies which elicit muscular contraction.

The amount of current passing through the coil can be regulated on the graduated scale on the top of the Inductotherm machine. (Photo No. 5)

Heat lost from the skin surface of the body depends on three factors: the temperature of the surrounding air, its saturation with water vapour and its rate of movement. By far the most important of these factors is the air temperature.

The air conditioning apparatus, which is situated in the base of the cabinet, consists of an electric motor and fan, low temperature radiator and humidifying tray. The humidifying tray is filled with water and standing in the water is a metal rack carrying several folds of white lint.

The air temperature within the cabinet may be automatically regulated to any degree from 80 to 110°F. by setting the thermostat (photo No. 6) at the foot of the cabinet. The air saturation is maintained at 80 - 85% as the warmed air coming from the radiator passes over the moist white lint standing in the humidifying tray. The fan circulates the air within the cabinet at approximately 50 cubic feet per minute.

Once the desired febrile plateau has been reached by/
by the penetrating heat of electromagnetic induction
the atmospheric conditions present in the cabinet are
usually sufficient to maintain the body temperature at
105°F. to 106.4°F.

In the event however, of the temperature and
saturation of the air within the cabinet failing to
maintain the body temperature at a certain level, the
inductotherm may be switched on at a reduced intensity
for a short period. This quickly overcomes any slight
tendency for the body temperature to fall on cold
days or when the sliding doors have been opened during
attention to the patient.

Accessory Equipment.

In order to provide for the immediate treatment
of any emergency which may arise in the course of
fever session it is necessary to have instantly
available:-

1. Ampoules of Coramine (Ciba) for intramuscular
   injection.

2. Cylinders of oxygen, and oxygen with 5% carbon
dioxide, and appropriate face pieces.

3. An intravenous drip apparatus (e.g. Vacoliter),
   sterilised and set up ready for use.

4. Sterile flasks of 0.9% saline with 6% glucose for
   intravenous use.

The photographs 1 to 6 show the lay-out of fever
cabinet and accessories.
Photo. No. 1.

General view of layout in the Treatment Room, with cabinet open and the accessories required.
Photo. No. 2.

View of exterior of cabinet.

C.L. Lock for fastening cabinet.
F.C. Filler cup for replenishing water in humidifying tray.
H.R. Adjustable head rest.
I. Inductotherm machine.
N.T. Neck towel, hanging from towel bar.
P.F. Portable fan.
S.C. Stop Cock for draining humidifying tray.
S.D. Sliding doors.
S.S. Switches for inspection lamp, and heating unit with "tell tale" lamp.
T. Thermometer for recording air temperature in cabinet.
Photo. No. 3.

View of Interior of Cabinet.

ATC. Automatic temperature control mechanism.

IL. Inspection lamp.

M. Mattress, with Turkish towel covering.

T. Bulb of the thermometer which records air temperature in the cabinet.

1. Pilot light.

2. Dial for setting intensity of Inductotherm current.

3. Inductotherm switch.
Photo. No. 4.

View of interior of cabinet with mattress and supporting boards removed to show heating and humidifying unit. The lid, which covers the humidifying unit has also been removed.

C. Insulated coil.
C.L. Cabinet lock.
H.R. Adjustable head rest.
I.L. Inspection lamp.
R. The low temperature radiator, behind which is the fan.
W.L. Folds of white lint arranged on rack standing in humidifying tray.
Photo. No. 5.

Enlarged view of Inductotherm from above showing pilot light, dial for setting intensity of Inductotherm current and switch.
Photo. No. 6.

Automatic temperature control (thermostat) for regulating air temperature within cabinet.
Preparation of The Cabinet.

The technique necessary to put the cabinet in working order prior to administering a treatment is as follows:

(1) The humidifying tray is filled with sufficient hot water (Temperature \(110^\circ F\)) through the filler cup and the level of water brought to within \(1/8\)th inch of the top of the cup. During treatment this water level is checked every hour so as to keep the humidifying tray filled.

(2) A square of white lint is draped over the humidifier rack, which is placed in the water in the tray and the lid put in position. The centre piece of mattress board is then replaced in position.

(3) The mattress is covered with its washable Turkish towel and this is secured on the under surface by the tie-strings. The mattress is laid on the mattress board and is therefore resting directly on the single loop of the inductotherm cable. The mattress is so placed that the end with the metal zip fastener is at the head end, and a pillow covered with a mackintosh square and a soft towel laid there.

(4)
(4) The cabinet is now shut and locked. Another towel is draped over the head opening from the towel-bar.

(5) The thermostat is set to $110^\circ F$, and the current to the fan and heater turned on. The heating and humidifying unit is allowed to operate until the temperature of the air within the cabinet reaches $110^\circ F$, as shown by the spirit thermometer on top of the cabinet.

The pre-heating time varies according to the general air temperature. During the winter months about 45 minutes is necessary. In summer this time is reduced to about half an hour. During this time it is unnecessary to have an attendant present as the thermostat automatically maintains the temperature at $110^\circ F$.

(6) Just prior to beginning the treatment the Inductotherm machine is connected to the cabinet.

**Induction of Pyrexia.**

The current to the fan and heating unit is switched off, after which the cabinet is unlocked and opened up.

The patient, completely undressed, is laid on his back, with his head on the pillow, which is supported by the adjustable head-rest.

The cabinet top is lowered gently, care being taken to see that the edges do not bruise or chafe/
chafe the patient's neck or shoulders.

The cabinet is closed and locked. The patient is asked if he feels comfortable and care taken to see that the pillow and neck towel (draped from the towel-bar) are comfortably placed. The purpose of this towel is to prevent warm air escaping from the cabinet between the rubber neck piece and patient's neck. The current to the fan and heating unit is turned on again.

Commencing observations are now made of the -
(a) pulse rate;
(b) respiratory rate;
(c) temperature - taken per rectum;
(d) blood pressure.
and those recorded. - Se photographs of charts.
(a) The pulse rate at the outset may be taken from the radial artery in the usual way but thereafter it is taken from the temporal artery crossing the zygomatic arch.
(b) The respiratory rate is taken by counting the chest or abdominal movements - access being obtained by partly opening one of the sliding doors.
(c) The temperature is taken with a certified clinical mercurial thermometer. Access for its insertion into the rectum is obtained by sliding the lower door towards the foot of the cabinet.
(d)/
(d) It is preferable to take the initial blood pressure reading with the patient in the cabinet. Access to apply the cuff of the blood pressure apparatus is obtained by sliding the upper door towards the foot of the cabinet.

After completing these observations the inductotherm is now turned on at the maximum intensity (dial reading - 100) and thermostat is set to maintain the cabinet temperature at 110°F.

Throughout the period during which the inductotherm is operating the patient is instructed to lie flat on his back with the legs stretched out.

During a treatment it is necessary to record -

(a) pulse rate - every 15 minutes.
(b) respiratory rate - " 15  \\
(c) temperature - " 15  \\
(d) blood pressure - It is generally
advised that the blood pressure should be recorded every thirty minutes. I have not found it necessary to carry out this recommendation in all cases. Where there was any doubt as to the cardio-vascular system, the blood pressure was taken regularly, and, in the first treatment of any patient it was taken frequently. Thereafter, I found, that as a rule, the temperature, pulse and respiratory rates formed sufficient guides to the patient's progress. 

During/
During the operation of taking the rectal temperature it is essential to cut off the inductotherm machine, for if this were left running a false reading would be obtained owing to the current affecting the mercury.

In the first treatment of any patients, when the rectal temperature has reached to within 1°F. of the desired temperature the inductotherm current is cut off. This is done in order to allow for a possible increase in the patient's temperature after cessation of the inductotherm. It was found that in certain cases the temperature continued to rise for \( \frac{1}{2} \) to \( \frac{3}{2} \)°F. before becoming steady. In other cases, and particularly in the later treatments of certain cases, it was necessary to keep the inductotherm on until the patient's temperature was up to the desired level. The current could then be cut off entirely or reduced to a certain intensity, e.g., dial reading of 50. (see photo. 5).

**Maintenance of Pyrexia.**

It was found necessary in all cases during the winter months to keep the thermostat at 110°F. During the summer, it was necessary to reduce the thermostat setting to level of 106°F to 108°F. The thermostat level necessary for the maintenance of a steady/
steady temperature for each case can only be found by experience.

In two cases it was also found necessary always to keep the inductotherm machine running on a reduced amount of current, e.g., dial reading of 60.

Termination of Pyrexia.

The thermostat is turned off to $80^\circ F$. The sliding doors on both sides of the cabinet are opened. The patient is dried down. The portable fan is operated continuously, first on the face of patient and thereafter through the sides of the cabinet - the operator moving round from one side to the other so that any one area of the patient is not unduly chilled. The customary observations on temperature, etc. are made during the defervescence.

The process of cooling requires half to one hour. The patient may be transferred to bed when his temperature has fallen below $102^\circ F$. When this level is reached the cabinet is unlocked and opened up and the patient dried down. He is dressed in a long flannel nightshirt and taken to the ward on a trolley.

For about two hours following the treatment patients did not feel inclined for food but continued to drink freely. Thereafter a supper of scrambled or poached eggs was frequently requested.

Prior to settling down for the night the patient changed/
changed from the flannel nightshirt into his own pyjamas. Patients usually fell asleep at their normal bed time. Only occasionally was it necessary to administer sedatives on the night after a treatment.

**MANAGEMENT OF THE PATIENT DURING A TREATMENT.**

An important part of the patient's preparation for treatment consists in describing the procedure to him. He is told that the treatment will probably give him relief from his arthritis and that his infection will be cured. It is explained that treatment is long and tedious, that the cabinet is very hot, that he may suffer slight headaches and herpes labialis after a treatment, but that everything in the way of drugs and attention will be allowed to make it as easy for him as possible. None of the patients expressed any doubt about the procedure or hesitated to continue their treatment once started.

During the time of rising temperature certain patients experience some difficulty. How troublesome this period of apprehension or excitement becomes, depends almost entirely on the mental calibre of the patient. If he is determined to secure the benefit he desires and is able to exert self-discipline the difficulty is easily surmounted. The average patient is very cooperative and after the temperature reaches a stationary level may go to sleep for short periods.
The general reaction of the patient throughout the treatment can be improved by close attention to many small details.

His face should be shielded from any bright light. All extraneous noises should be eliminated as far as possible. During the first hour he may be allowed to converse freely, but thereafter he should not be encouraged to talk.

**Fluid Intake.**

During all stages of a treatment patients feel thirsty, but particularly so, during the maintenance of the temperature at a high level. The thirst is conditioned to a great extent by the amount of body fluid lost through sweating, but in many treatments the chief complaint was dryness of the mouth which induced liberal drinking.

The patients were asked frequently, e.g., every 10 to 15 minutes if they wished to drink, and their requests for fluid immediately granted.

The choice of fluids included:-

(a) glucose with orange;
(b) plain water.
(c) bovril;
(d) Milk;
(e) weak tea;
(f) 6% glucose in 0.9% saline.

The most popular fluids were glucose with orange and/
and plain water. Bovril and milk were inclined to cause nausea and vomiting. For those patients who complained of a sense of exhaustion it was found that the oral administration of .9% sodium chloride with 6% glucose, followed by a mouthful of cold water to rinse the mouth, was particularly acceptable.

Food.

One patient felt the desire for solid food and ate small pieces of sponge cake and biscuit.

Sedatives:

It appears from the literature that the most disagreeable sensations are encountered when the temperature is in the region of 102 - 103°F. With the first treatment in any series this fact was frequently noted, but during the second and subsequent treatments the patients did not appear so much perturbed. Reassurance that this phase of discomfort was only temporary was sufficient in most cases.

I found it frequently advantageous to give Omnopon grain 1/6th orally about one hour after the plateau level had been obtained. This ensured a fairly tranquil state of mind for the next two hours or so, after which time the patient could easily be kept placid by telling him how soon his treatment could be finished. A slight degree of cyanosis occasionally developed from the use of Omnopon, but this/
bodies. Certain cases who are unable to do so, and, in the later stages of a treatment, those who feel too weak, are dried down.

It is important that during the period of induction the patient be dried down frequently so that no pools of sweat accumulate in the natural body hollows.

After the induction period, the patient is told that he may lie in any position which he finds comfortable. Frequently patients find it pleasant to lie on one side with the knees drawn up or prone with the face turned to one side. Slight adjustments in the height of the head rest and neck towels may be necessary to ensure the maximum comfort.

Air circulation: Many patients found a sense of oppression and suffocation continually present. This was relieved by blowing air over their faces from the electric fan at frequent intervals. This intermittent stimulation was very pleasing to the patient. Alternatively cold compresses to the forehead were used but those required changing about every two to three minutes.

Bladder: During the treatment patients often felt the desire to micturate. A glass urinal was passed through one of the sliding doors without interruption of the treatment.
Photo. No. 7.

Patient at height of temperature showing profuse sweating on face and forehead.
RISKS OF FEVER THERAPY.

It is generally acknowledged that the production of a general elevation of temperature is not entirely free from danger or disadvantages.

Apart from a slight risk of localised superficial necrosis of skin in the region of the buttocks, the dangers, to which a patient is exposed in inductopyrexia do not differ from those which occur in any other form of pyrexial therapy. Provided that the temperature level is not higher than $106.7^\circ$F, it is generally the cardio-vascular system which first exhibits signs of stress. With higher temperature levels, neurological complications are of more frequent occurrence.

The importance of taking regular observations of the pulse, temperature, respirations and blood pressure, is therefore evident. Certain limits to those figures, and other observations are regarded as indications to discontinue a treatment.

**Indications for cessation of a treatment:**

1. A pulse rate exceeding 160 per minute.
2. A systolic blood pressure below 80 mgms of mercury.
3. A rectal temperature over $107.5^\circ$F.
4. A respiratory rate over 40 per minute or the development of Cheyne-Stokes respirations.
5. Violent delirium, coma, or generalised tremor.

On the one occasion when it has appeared necessary to discontinue a treatment the procedure followed was:

1. /
1. the current to both heating units was turned off;
2. the cabinet was unlocked and opened up;
3. the portable fan was set to play on patient's face;
4. he was sponged down with a towel rung out of cold water;
5. one ampoule of Coramine was given intramuscularly into the thigh.

**Minor complications:**
These are few and comprise:
1. Herpes of the lips.
   This appeared in three patients towards the end of a treatment. It was never severe, it subsided under ordinary cleansing and dusting the area with borated starch powder.
2. Headache: two patients complained of headache after a treatment. It usually disappeared without medication after a night's rest.
3. Vomiting: one patient vomited once whilst in the cabinet. He attributed it to taking orange juice. The accompanying aching in the epigastrium was relieved by one drachm of bicarbonate of soda in water.
PERSONAL EXPERIENCES OF INDUCTOPYREXIA.

On account of the great variation in mental and physical reactions shown by different patients whilst in the cabinet, it seemed appropriate for me to try the effect of a short fever treatment.

Immediately the inductotherm was turned on (12 noon) I experienced a slight generalised tingling which lasted about two minutes and gradually disappeared. This transient sensation of tingling recurred every time the inductotherm was switched on. It was in no way unpleasant or alarming.

After ten minutes I began to perspire, and in about twenty minutes I felt the carotid arteries throbbing in the ears and also noticed a tendency to irregular breathing with sighing.

I drew up my knees for a minute and also turned on my side and found that these manoeuvres reduced the sensation of heat being forced into the body.

Just after 12.45 I took my first drink of cold water and after it I felt I could tolerate the heat better. From now, up to 1.15 p.m. when the inductotherm was finally turned off, it required an increasing mental concentration to remain lying flat with the legs and arms stretched out. By this time, turning the head from side to side was inclined to produce a temporary/
temporary dizziness.

At 1.15 p.m. the inductotherm was turned off and I allowed my temperature to "coast on" for fifteen minutes, with the thermostat set for a cabinet air temperature of 110°F.

During this period, even though my temperature was still rising, the sensation of heat entering the body was entirely absent. I felt disinclined for any exertion and almost as if I could go to sleep. The slight noise produced by the electric motor in the humidifying unit did not trouble me.

Shortly before one o'clock I required a urinal but now (1.20 p.m.) I experienced the sensation of passing urine involuntarily. The urine came away in small quantities before I had time to ask the nurse for a urinal.

Despite the slight drowsiness and disinclination for any exertion I clearly realised when it was 1.30 by hearing a dinner bell ringing in an adjoining ward.

At 1.30 the thermostat was turned to 90°F. and the sides of the cabinet opened up. The sensation of cooling was very pleasant, particularly the portable fan turned on the face. Muscular power began to return about 10 minutes later and the sensations now resembled that experienced when coming out of gas and oxygen anaesthesia. Just before 2.0 p.m. (Temp./
(Temp. 102.7°F.) I noticed a slight frontal headache, and at 2.10 p.m. (temp. 101.6°F.) I was still perspiring freely. At 2.15 p.m. I sat upright and felt slightly dizzy, but able to have a bath and then went to bed and slept till 4.15 p.m. On waking the headache and dizziness had disappeared completely.

This short "treatment" convinced me that there is nothing bizarre in a procedure which, at first sight, might appear to a patient to be rather frightening.

Incidentally, it impressed on me the necessity for enquiring more frequently than I had previously been in the habit of doing, if the patient required a urinal.

Photo of "Treatment" Chart.
An increasingly large number of clinicians are using artificial pyrexia in the treatment of gonorrheal arthritis and it is appropriate to review briefly the methods used, the types of cases treated and the results obtained, in order to have standards with which to correlate the results obtained by inductopyrexia.

The majority of reports come from American clinicians who have used the Kettering hypertherm. The method employed in this type of fever treatment is the circulation of hot air at known temperature (130 to 150°F.) and humidity over the patient's body in an insulated cabinet so that the patient's temperature is raised by direct absorption of heat through the skin. The effect on the patient's temperature is identical with that produced by inductopyrexia, except that the gradient of the temperature rise is steeper.

Hench, Slocumb, and Popp (1935) treated nine cases of acute and seven cases of chronic gonorrheal arthritis. The average duration of the arthritis was thirteen days in acute cases and twelve months in the chronic cases.

They gave from three to seven treatments to each case and noted that symptomatic relief is often obtained/
obtained after the first treatment. Only one patient
did not obtain benefit – a case of residual chronic
gonorrhoeal arthritis with roentgenographic evidence
of destructive arthritis and with marked stiffness of
the knee joint. They concluded that patients with
acute arthritis of less than four weeks duration
had a very favourable prognosis – 88 per cent. being
cured.

They believe that even in cases of old chronic
gonorrhoeal arthritis in which the continued presence
of viable gonococci may seem remote, and secondary
invaders are under great suspicion, a trial of a few
sessions of fever is nevertheless in order and
particularly if tenderness, swelling and pain on
movement of the joint are present.

Kendall, Webb and Simpson (1935) gave therapeutic
fever to a patient with syphilis who also had a gonorrheal arthritis of the right wrist of 5 months dura-
tion; urethral smears were positive for gonococci.
He was given three weekly treatments each of 105°F.
and all evidence of arthritis disappeared. Subse-
quently they treated 31 patients with gonorrhoeal
arthritis with 5 – 7 hour sessions at 106°F. to
106.7°F. They began with a weekly interval but
found that fewer treatments were needed if the
interval was cut to 4 to 5 days. They advised a
minimum course of four treatments. They treated 19
patients/
patients with acute arthritis, 13 of whom recovered completely, and 12 patients with chronic arthritis of whom 5 recovered completely.

Ultimate results on these patients during the follow-up period showed an average of 98.4% return of function in the patients treated for acute arthritis, and among the patients with chronic arthritis 88.3% improvement. They advised local physical therapy after the sessions of fever.

Owens (1936) treated twenty-two cases of gonorrhoeal arthritis in the Kettering Hypertherm. Of these 14 were cured, and 8 were regarded as improved. Every case was relieved and the prospect of cure improved with adequacy of treatment.

In the cases which were cured -

(i) the average number of treatments was 4.8 hours.
(ii) the average duration of treatments was 4.6 "

Owens regards all failures to cure gonorrhoeal arthritis as due to insufficient pyrexia.

Owens believes that with this form of treatment, a patient with gonorrhoeal arthritis can be promised that, if he can stand the treatment he will be cured and, that, in a reasonably short time.

Trautman, Stroupe & Devlin (1937) treated 69 cases of gonorrhoeal arthritis in the Kettering hypertherm at the U.S. Marine Hospital, New Orleans.

Treatments were given at first weekly but later every/
every 3 days. The temperature was maintained at 106-107°F., except in the case of the first treatment in any series, in which it was kept at 105-106°F.

All patients were carefully examined to exclude cardio-vascular or renal disease. They were under constant observation during treatment which was discontinued if necessary. Eight cases did not complete treatment.

Of 37 cases of acute arthritis -
31 showed marked improvement or cure.
6 showed moderate improvement.

Average number of treatments was 8.1.

Of 24 cases of chronic arthritis -
13 showed marked improvement,
6 showed moderate improvement.
3 showed slight improvement.
2 showed no improvement.

Average number of treatments 6.8

Parsons, White, Hardaway and Barnes, (1937) state that from their own experience artificial fever therapy is a definite addition to therapeutics. They found the Kettering hypertherm satisfactory, but consider that more important than the apparatus is the presence of a well-trained nurse technician and a medical officer in constant attendance.

The authors returned to duty, patients with gonorrhoea treated by this method, apparently well in less than 10 per cent. of the time usually lost with this disease.

Williams/
Williams (1937) treated 16 patients suffering from gonococcal arthritis at the Vanderbilt University Clinic. The Kettering hypertherm was used.

The rectal temperature was held between $105^\circ$ and $106^\circ$ F. for about five hours.

Six patients with arthritis of less than four weeks duration received an average of 4.3 treatments.

Five patients had a complete recovery.

One patient improved moderately.

Ten patients with arthritis of over four weeks duration received an average of six treatments. Following this there was no evidence of active infection in the joints of any patient.

King (1937) stresses the fact that treatment is strenuous and involves the patient in considerable discomfort and stress. It should never be lightly undertaken and patients should be selected and prepared as carefully as for a major surgical operation.

In an account of his personal observations at Dayton, Ohio, where he saw cases of gonococcal arthritis treated, he describes how one patient with a very severe arthritis of the wrist joint had almost complete symptomatic relief after one session of five hours at $105$ to $106^\circ$ F. Two further treatments given at three day intervals removed all signs of inflammation and after them, movements of the joint were full and free. At the same time all the associated/
associated signs of urethritis and prostatitis had completely disappeared.

Another case was that of a patient with gonococcal urethritis and multiple arthritis involving both knee joints and one ankle joint. There was much peri-articular infiltration of the affected joints and gross wasting of the muscles above and below the knees so that he had been bed-ridden for some weeks. He improved rapidly under treatment and after the fourth session was able to walk without the aid of crutches. All signs of the active infection process had disappeared and the subsequent treatment consisted of massage and movements.

King is convinced that for certain forms of gonorrhoea - forms in which the disease exercises its worst effects on the patient's health, sometimes crippling him for many months - no other treatment approaches artificially induced hyperpyrexia in efficiency.

Schnabel and Fetter (1938) treated 93 patients with gonococcal arthritis. They used the Kettering hypertherm and their treatment consisted of six hour periods with the rectal temperature at 106° - 107°F.

Of 70 cases suffering from acute arthritis -
- 43 were cured,
- 16 showed marked improvement,
- 6 showed moderate improvement.

Of 23 patients suffering from chronic arthritis -
- 6 were cured,
- 17 were improved.
The authors state that they have not found a single case of gonococcal infection which did not respond to some extent under adequate fever therapy.

Bauer and Cecil (1938) record their experiences with the Kettering hypertherm on 71 cases divided into acute, subacute and chronic.

67 cases had multiple joints affected. They stress the contraindications to hyperpyrexia and the complications occurring during treatment.

Contra-indications:

1. Organic heart disease which is not quiescent and compensated.
2. Systolic blood pressure over 150.
3. Renal disease.
4. Pulmonary infections, tuberculosis and asthma.

Major complications which they regard as a sign for the immediate cessation of treatment are:

1. Tachycardia - over 160.
2. Slow and irregular breathing accompanied by cyanosis.
3. Derangement of heat centre - temperature over 107°F.
4. Delirium, convulsions and coma.

Results:

<table>
<thead>
<tr>
<th>Classification</th>
<th>No of Cases</th>
<th>Complete symptom</th>
<th>Improved</th>
<th>Failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>24</td>
<td>12</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Subacute</td>
<td>39</td>
<td>18</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Chronic</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>
Cheetman (1929) records four cases of gonorrhoeal arthritis which were treated in a short-wave diathermy, air-conditioned cabinet. The recovery was complete in all cases.

From a consideration of these reports on the use of artificial fever therapy in gonorrhoeal arthritis it is evident that the average duration of incapacity is shortened and the percentage of cases able to return to work is greater than that obtained with treatment by more conservative methods.
CASE RECORDS.

I have been able personally to undertake the treatment, in the Edinburgh Royal Infirmary, of six cases of gonorrhoeal arthritis with artificial fever produced by the Inductotherm Fever Cabinet.

The case records are described in detail because they illustrate well the scope and effects of Inductopyrexia.

At the end of each case record a photograph of one of the charts made during a treatment, is placed. The photograph shows the extent of the pyrexia and the observations made during the treatment.

Admitted on 14.11.39 from Ward 23 in which he had been since 25.9.39.

History: This patient repeatedly denied any exposure to infection, but admitted frequent visits to dance halls and had several girl visitors whilst in the ward.

From 28.8.39 to 4.9.39 he was troubled with dysuria. One week later he noticed fleeting pains in the joints of elbow, shoulder, wrist and big toe, and he was admitted to the medical wards as a case of rheumatic fever, but on 9.11.39 the Gonococcal Complement Fixation test was found to be moderately strong positive.

Clinical findings on admission: Patient was confined/
confined to bed. He was under-weight, toxic looking and sweating freely. All movements of both elbows, wrists and knees were restricted, particularly extension. Passive movement beyond the range of active movement was painful. Above and below the affected joints there was extensive muscular wasting, and the wrist joints showed a slight degree of the deformity characteristic of early rheumatoid arthritis.

In addition, keratodermia blenorrhagica was present on the feet.

**Synopsis of Investigations and Treatment prior to Fever Therapy.**


15.11.39: Wassermann reaction: Negative.

Gonococcal Complement Fixation test: Weak Positive.

16.11.39: Prostatic Smear: Large numbers of pus cells and many gonococci present.

Gonococcal Complement Fixation test: Weak positive.

17.11.39: A course of sulphapyridine of 5 grams per day was begun and completed on 22.11.39, totalling 30 gms.

18.11.39: Massage to the affected joints was begun daily.

22.11.39: Urethral Smear: Pus cells present but no gonococci.

Prostatic Smear: Epithelial cells present only; gonococci not found.

Gonococcal Complement Fixation test: Weak positive.
Summary of Fever Treatments:

<table>
<thead>
<tr>
<th>Date</th>
<th>Total duration in hours</th>
<th>Duration and height of fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 28.11.39</td>
<td>4½</td>
<td>2 hours at 103.5°F.</td>
</tr>
<tr>
<td>2. 1.12.39</td>
<td>8</td>
<td>4 hours at 104°F.</td>
</tr>
<tr>
<td>3. 4.12.39</td>
<td>6</td>
<td>2 hours at 104°F.</td>
</tr>
<tr>
<td>4. 7.12.39</td>
<td>6½</td>
<td>3 hours at 104°F.</td>
</tr>
<tr>
<td>5. 11.12.39</td>
<td>8½</td>
<td>4½ hours at 105°F.</td>
</tr>
<tr>
<td>6. 14.12.39</td>
<td>7½</td>
<td>3½ hours at 105°F.</td>
</tr>
</tbody>
</table>

Progress:

Massage followed by passive and active exercises to the affected joints was continued daily until 18.12.39.


18.12.39: On his discharge from ward 45 he was instructed to attend for redevelopment exercises at the Massage Department, and to report at the out-patient department for "follow-up" examination.


Gonococcal Complement Fixation test: Weak positive.

Results of Treatment:

This patient did not attend regularly for a detailed "follow-up" to be completed, but on 3.2.40 the clinical findings were:
Elbow joints: Limitation of extension by about 2° on both sides.

Knee joints: Full range of painless movements present.

Wrist joints: The range of movement was full and powerful on each side but accompanied by a slight crepitus though there was no pain.

Gonococcal Complement Fixation test: Negative.

Culture of prostatic urine: No organisms found.

The keratodermia blenorragia had disappeared completely.

Though requested to return for observation, he defaulted; but in response to an enquiry however it was elicited that he was in the Army (R.A.M.C. - Field Ambulance). It is therefore presumed that recovery from his arthritis was complete.

Summary.

This is one of the most satisfactory cases treated with inductopyrexia, in spite of a lack of full cooperation from the patient. The clinical response of the urethritis and prostatitis to sulphapyridine was dramatic, but this was completely surpassed by the immediate cessation of joint pain and return of movement after the second pyrexial treatment. Prior to the institution of inductopyrexia he had been bedridden for seven weeks and after a fortnight's treatment he was able to walk about the ward.
Chart of 6th Treatment.
R.M. Male, age 41, Single.
Admitted 24.10.39.

History: He acquired gonorrhoea in San Francisco in 1925, and was inadequately treated for this. Two weeks after the onset of symptoms he developed an arthritis of left knee, and was apparently treated for this by pyrexial therapy consisting of injections of typhoid vaccines, with rapid improvement. The arthritis became quiescent until 1938, when the right knee became affected for which he was again treated by typhoid vaccine injections, but with less successful results.

His present complaint is that of -
(1) pain, swelling of and inability to use both knees;
(2) blurred vision in the left eye.

On Examination: Pale and toxic: rather melancholic and introspective. He is confined to bed. There is no urethral discharge, frequency or dysuria.

Right Knee Joint: Extension is limited by 15° and flexion to 70°.

Left Knee Joint: Extension limited to 10° and flexion to 90°.

Both joints contain a small quantity of free fluid and there is considerable thickening of synovial membrane of both joints.

There is a subacute iritis of the left eye, most severe in the lower nasal quadrant.
Synopsis of Investigations and Treatment prior to Fever Therapy.

1. Wassermann reaction: Negative.
3. Culture of a sterile catheter specimen of urine gave no growth.
4. Prostatis smear - showed no increase in the number of pus cells present.
5. Radiological Examination:

There is considerable swelling around the knee joints and muscular atrophy above and below the joints. The joint spaces are partially obliterated and there is slight osteo-arthritic lipping at the margins of the joints.

A radiograph of the chest showed no abnormalities in the lungs or heart.

Electrocardiogram: Normal.

Ophthalmologist's Report: There is slight irritation of the iris in the left eye, evidently indicating an old iritis.

Blood urea - 10 mgms %.

1.11.39. A course of sulphapyridine of 5 grams daily was begun and finished on 10.11.39. This produced no change in the condition of the joints and he was advised to undergo a course of fever therapy.

Summary of Fever Treatments.

<table>
<thead>
<tr>
<th>Date</th>
<th>Total Duration</th>
<th>Duration and height of plateau.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 29.11.39</td>
<td>7</td>
<td>4 hours at 104°F.</td>
</tr>
<tr>
<td>2. 5.12.39</td>
<td>8</td>
<td>4 &quot; at 104°F.</td>
</tr>
<tr>
<td>3. 8.12.39</td>
<td>7½</td>
<td>5 &quot; at 103°F.</td>
</tr>
<tr>
<td>4. 12.12.39</td>
<td>8½</td>
<td>4 &quot; at 104.8°F.</td>
</tr>
<tr>
<td>5. 15.12.39</td>
<td>7½</td>
<td>4 &quot; at 103°F.</td>
</tr>
</tbody>
</table>
Notes on the Treatments.

Though none of the absolute contra-indications to treatment was present here, the patient was a poor subject to undergo pyrexia. He was melancholic and pessimistic in outlook and would do little to help himself.

At the commencement of a treatment he drank freely for about an hour and then flatly refused to take more fluid by mouth, as he developed slight abdominal discomfort. It was therefore necessary in all the treatments to give him a drip saline infusion into the ante-cubital veins. The amount of saline varied from 800 c.c. to 2 litres.

Later in the treatment his systolic blood pressure always fell to below 100 mm. and on two occasions to below 90 mm. He was therefore given 1.7 c.c. Coramine intramuscularly. This resulted in an immediate rise in the systolic blood pressure often amounting to over 20 mm., and allowed the treatment to be continued.

Effects of Treatment.

As there was no increase in the range of joint movements and it was clearly evident that he was making no progress after five treatments, pyrexic therapy was discontinued, and he was referred to an orthopaedic surgeon.
The gonococcal complement fixation test remained strongly positive during and after the pyrexia. There was a slight exacerbation of the symptoms of the iritis following each treatment. On the day after each treatment an eye shade was worn and the symptoms subsided spontaneously.

**Summary:**

The diagnosis in this case was that of a residual chronic gonorrhoeal arthritis with radiological evidence of a proliferative arthritis. The presence of viable gonococci in the genito-urinary tract or in the joints was not demonstrated, but a short trial of fever therapy was recommended as he had derived little benefit from all other previous forms of treatment.

By itself, the temperature attained would have been insufficient to kill any gonococci, but it was hoped that the other systemic effects produced by the fever would relieve the pain and tenderness in the joints.

**Chart of 4th Treatment.**
Admitted 14.11.38.

History: He admitted extra-marital intercourse six weeks prior to admission. Three weeks thereafter he had noticed some irritation at the penis and five days previously a urethral discharge was present. The left knee and right ankle had been painful for two weeks.

Examination.  
14.11.39. On admission he was feeling feverish and ill. There was a purulent urethral discharge showing gonococci on microscopical examination. Both urines in the two glass test were hazy. The prostate was moderately enlarged. There was an acute arthritis of the left knee and teno-synovitis of the right ankle and right wrist.

Wassermann reaction: Negative.  
Gonococcal Complement Fixation test: Negative.

Synopsis of Investigations and Treatment prior to Fever Therapy.  
14.11.39. A course of sulphapyridine (6 gms. per day) was begun and continued until 26.11.39. The total dosage was 55 gms. Urethral and prostatic smears thereafter showed a few pus cells but no gonococci, and both urines in the two glass test were clear. There was no clinical improvement in the joints.

30.11.39./
30.11.39. Electrocardiographic examination was normal. Radiological examination of the chest showed slight emphysema. An X-ray of both knee joints showed no bone changes. The blood urea was 14 mgms. per cent.


Summary of Fever Treatments.

<table>
<thead>
<tr>
<th>Date</th>
<th>Total duration in hours</th>
<th>Duration and height of plateau</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 18.12.39</td>
<td>6½</td>
<td>4 hours at 104°F.</td>
</tr>
<tr>
<td>2. 21.12.39</td>
<td>8½</td>
<td>4 &quot; over 106°F.</td>
</tr>
<tr>
<td>3. 28.12.39</td>
<td>7½</td>
<td>4 &quot; over 106°F.</td>
</tr>
<tr>
<td>4. 2.1.40</td>
<td>8¾</td>
<td>4 &quot; over 106°F.</td>
</tr>
<tr>
<td>5. 5.1.40</td>
<td>8½</td>
<td>4 &quot; over 105°F.</td>
</tr>
</tbody>
</table>

Progress:

8.1.40. He was referred to the Massage Department to begin developmental exercises in the gymnasium.

Culture of the urine obtained after prostatic massage did not reveal any gonococci.

9.1.40. The Gonococcal Complement Fixation test was "doubtful negative".

He spent the next three weeks as a convalescent patient in the ward and rapidly regained his weight.

3.2.40. Examination showed full range of painless movement of knee, wrist and ankle joints on both sides. Culture of the prostatic urine was again negative.

He was discharged from the ward, but continued as an out-patient for a fortnight at the Massage Department.

24.2.40./
24.2.40: Reporting: Feels well and has no complaints. The condition of the joint is very satisfactory.

4.5.40: Reporting: Is now working in his former occupation at the iron works; feels well and able for his job. A final gonococcal complement fixation test was returned as negative.

Summary:

This case illustrates well the perfect result which can be achieved from a co-operative patient, who is physically fit to undergo inductopyrexia, and whose arthritis is in the early acute stages.

Chart of Third Treatment.
Admitted 9.10.39.

History:— Two years and nine months prior to admission he was treated in Japan for gonorrhoea with tablets and irrigations. He did not know the name of the tablets or irrigating solution. Nine months later the right knee joint became swollen and painful on movement. He received radiant heat treatment at Kelso Hospital with symptomatic improvement only. Within the six months prior to admission, both elbows and the left ankle became similarly affected.

On examination: Patient is very pale, thin and toxic. He states he has lost 3 stones of weight in six months. Appetite: indifferent; Bowels: regular; Tongue: dry and furred. Right and left knees: Both joints contain a large effusion. Active movement is restricted to a range of 40° in both joints.

Right elbow: Active movement limited by 20° short of full range in both flexion and extension.

Left Elbow: Active movement limited by 10° short of full range in both flexion and extension.

Left ankle: Movement in all directions is limited and accompanied by pain.
Synopsis of Investigations prior to Fever Therapy.

Prior to admission to this ward, fluid had been aspirated from the knee joints, examined on films and culture for gonococci with negative results.

10.10.39. Urethral Smear: A few pus cells were present but no gonococci.

Prostatic Smear: No gonococci found.

Culture of urine passed after Prostatic massage: Negative for gonococci.


Gonococcal Complement Fixation test: Negative.


10.11.39. Urine was tested for albuminuria and glycosuria with negative results.

30.11.39. Electrocardiogram: Sinus tachycardia with right axis deviation.

2.1.40. X-Ray Chest: Negative, i.e., no contraindication of fever therapy.

9.1.40. X-Ray Report: Both knees and right ankle show marked evidence of acute arthritis with considerable effusion. Appearances are those of gonococcal arthritis.

Left Elbow: No bone change is seen but there is an effusion into the joint.

X-Ray Teeth: No evidence of any septic foci present.

A report from a throat surgeon stated that the tonsils had been removed in childhood and no necessity for further action was necessary.
Treatment:
Prior to the commencement of fever therapy, he had (1) a course of 26 grams of sulphapyridine.
(2) Iron - as Pil. Ferrous Sulph, one t.i.d.
(3) Massage, and radiant heat to the joints.
No change in the clinical condition of the joints was apparent as a result of this treatment.

Summary of Fever Treatments, with later pathological tests:

<table>
<thead>
<tr>
<th>Date</th>
<th>Total duration in hours</th>
<th>Duration and height of plateau</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 10.1.40.</td>
<td>5 1/2</td>
<td>3 hours at 104°F.</td>
</tr>
<tr>
<td>2. 12.1.40.</td>
<td>4 1/2</td>
<td>2 1/2 &quot; &quot; 103°F.</td>
</tr>
<tr>
<td>3. 22.1.40.</td>
<td>5 1/2</td>
<td>2 1/2 &quot; &quot; 103°F.</td>
</tr>
<tr>
<td>4. 26.1.40.</td>
<td>5 1/2</td>
<td>3 1/2 &quot; &quot; 104°F.</td>
</tr>
<tr>
<td>5. 1.2.40.</td>
<td>3 3/4</td>
<td>2 &quot; &quot; 103°F.</td>
</tr>
</tbody>
</table>

16.1.40. The effusion in the right knee joint was aspirated and a Gonococcal Complement Fixation test performed on the fluid so obtained. This was negative. A direct film showed pus cells in large numbers but no organisms, and no growth was obtained on culture.


Effects of Treatment:
Following each treatment there was a temporary improvement in pain and an increase in the range of mobility/
mobility of the joints, but this rapidly lessened, and the 4th and 5th treatments were of little benefit. The treatment was so exhausting for him and his general condition became so weak that the treatments had to be discontinued, without any clinical improvement in the joints.

Discussion of Case.

On clinical grounds the case appeared to be one of multiple arthritis without any bony change in the affected joints. The diagnosis of gonococcal arthritis was made on the history, radiological appearances and the exclusion of other possible causes of multiple arthritis by systematic search for any septic focus.

Being in such a low state of health, the use of inductopyrexia was considered a risk, but he willingly submitted to it, when the serious nature of his illness was explained to him.

He stood the treatments much better than was expected though his temperatures were never up to the desirable level or duration. This inability to endure a sustained high temperature would appear to be the chief factor in the failure of this patient to derive benefit from Inductopyrexia.
Chart of 1st Treatment.
A.L. Age 30, Married.
Admitted 19.4.40.

History: - The patient came with a travelling card, (Form V.15) in which it was stated that he had been treated in the Army from 1.12.39 to 7.3.40 for gonorrhoea, complicated by arthritis of the right ankle, and had been invalided from the Army on 7.3.40 on this account. Prior to his arrival in Edinburgh, he had been treated with sulphapyridine and irrigations and a course of vaccine begun.

Previous History: -
(1) During the winter of 1934-35 he had injured his right ankle on two occasions at football, and had been off duty for ten weeks. The patient could give no accurate details as to the nature of the injury.
(2) In 1936, he had had gonorrhoea, which was treated at Aldershot.

Condition on admission: -
19.4.40. No urethral discharge. Both first and second urines were clear. Rectal examination of the prostate showed slight bilateral enlargement. The prostatic fluid, expressed by massage, contained numerous pus cells but no gonococci on microscopic examination.

Wassermann reaction: Negative.
Gonococcal/
Gonococcal Complement Fixation Test: very weak positive.

Right ankle: There is considerable peri-articular synovial thickening on all aspects of the joint. Flexion and extension is greatly limited - only about 20° range of movement is possible.

Tarsus: No inversion or eversion of the tarsus is present.

Synopsis of Investigations prior to fever therapy.

X-Ray - Right Ankle: No bony change present.

Electrocardiogram: Normal.

X-Ray - Chest: Normal.

Blood urea: 12 mgms. %.

As there was no contra-indication his fever treatment was begun immediately.

Summary of Fever Treatments:

<table>
<thead>
<tr>
<th>Date</th>
<th>Total duration in hours</th>
<th>Duration and height of plateau</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 26.4.40</td>
<td>$6\frac{1}{2}$</td>
<td>3 hours at 105.5°F.</td>
</tr>
<tr>
<td>2. 30.4.40</td>
<td>6</td>
<td>3 &quot; &quot; 105.9°F.</td>
</tr>
<tr>
<td>3. 3.5.40</td>
<td>$6\frac{3}{4}$</td>
<td>3 &quot; &quot; 105.7°F.</td>
</tr>
<tr>
<td>4. 6.5.40</td>
<td>7</td>
<td>3 &quot; &quot; 105.6°F.</td>
</tr>
</tbody>
</table>

Progress:

He was referred to the Massage Department on 27.4.40 and was given a course of massage and exercises/
exercises followed by a session in the "foot-drill" class.

On 10.5.40 he reported. There was no urethral discharge. Examination of the prostate gland revealed nothing abnormal and a prostatic smear was normal. The Gonococcal Complement Fixation test was repeated on 10.5.40 and 28.6.40 and was negative on both occasions.

He was discharged from the department on 28.6.40 and the clinical findings on that date were:

Right ankle: The range of extension is only 10° less than the left ankle.

Tarsus: Inversion, eversion and circumduction of the foot are now possible.

The Gonococcal Complement Fixation test was negative.

Summary.

This patient falls into the category of a monoarticular arthritis affecting a joint already the seat of previous trauma. The patient was a fit young man, who could well stand high temperatures, and who conscientiously attended for follow-up investigation and treatment.

In assessing the results of treatment, by purely orthopaedic standards, it is necessary to remember that the affected joint had already been damaged by trauma so that restitution of full function might be unobtainable.

By/
By the patient's testimony, he was able a fortnight after his discharge from the ward, to walk further than he had done during the whole of the previous six months, and at his discharge from the department on 28.6.40 he was intending to begin work.

Chart of 2nd Treatment.
F.D. Male, age 44. Married, (living apart).
Admitted to ward on 10.6.40.

**History:** He admitted exposure to infection on 1.6.40, and he noticed a slight urethral discharge accompanied by dysuria five days later.

On 6.6.40, the right knee became stiff and his left shoulder was painful but not stiff. On 10.6.40, the left knee became painful and also the first interphalangeal joint of the middle finger of the left hand was painful and swollen.

He had to stop work on 9.6.40 on account of the pain and stiffness of right knee.

**Previous history:** The patient had attended the department at irregular intervals on six occasions from 1920 onwards, and was treated for Gonorrhoea in 1926 and 1930. He is a very heavy whisky drinker.

**Condition on Admission:** He appears toxic and is in obvious pain. Temperature 101°F.

Mucoid urethral discharge present. Both urines of the two glass test are slightly hazy. There was no evidence of prostatic enlargement on rectal palpation.

**Right knee joint:** Prominent congested veins are seen coursing over the joint, which is greatly swollen, and the local temperature is raised. A gross degree of effusion is present and the range of active movement is/
is limited to 15° on account of the pain. There is considerable atrophy of the quadriceps femoris muscles.

**Left Knee joint:** There is slight effusion present and movement of the joint is painful but not limited.

**Left shoulder joint:** Movements are free in all directions.

**First interphalangeal joint (L):** The joint is swollen, painful, and movement is greatly limited in both directions.

**Synopsis of Investigations and Treatment prior to fever therapy.**

10.6.40. Urethral Smear: Pus cells present in large numbers along with gonococci (scattered).

Wassermann reaction: Negative.

Gonococcal Complement Fixation test: Weak positive.

The radiograph of chest, electrocardiogram and blood urea were within normal limits.

He was ordered 4 grams of sulphapyridine per day but this had to be stopped on 13.6.40, after he had a total of 11 grams, on account of nausea, sickness and abdominal pain.

**Summary/**
Summary of Fever Treatments:

<table>
<thead>
<tr>
<th>Date</th>
<th>Total duration in hours</th>
<th>Height and duration of plateau</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 11.6.40</td>
<td>6½</td>
<td>4 hours at 105.7°F.</td>
</tr>
<tr>
<td>2. 14.6.40</td>
<td>6½</td>
<td>4 &quot; &quot; 106.2°F.</td>
</tr>
<tr>
<td>3. 17.6.40</td>
<td>7½</td>
<td>4½ &quot; &quot; 106.0°F.</td>
</tr>
<tr>
<td>4. 21.6.40</td>
<td>7½</td>
<td>4 &quot; &quot; 106.0°F.</td>
</tr>
<tr>
<td>5. 26.6.40</td>
<td>8</td>
<td>4 &quot; &quot; 105.7°F.</td>
</tr>
<tr>
<td>6. 2.7.40</td>
<td>7</td>
<td>4 &quot; &quot; 105.8°F.</td>
</tr>
</tbody>
</table>

Progress:
12.6.40. **Right Knee Joint:** Movement is now possible through the full range and is only slightly painful at the extreme degrees.

**Left Knee Joint:** The pain has gone entirely.

13.6.40. **Urethral Smear:** Abundant pus cells present but no gonococci.

15.6.40. No urethral discharge and both urines now clear.

19.6.40. **Prostatic smear:** Epithelial and pus cells present in large numbers but no gonococci.

24.6.40. **Gonococcal Complement Fixation test:** Negative.

29.6.40. Both knee joints still contain a little free fluid and there is considerable bilateral wasting of the quadriceps femoris particularly on the right side. The first interphalangeal joint has a full range of painless movement and the swelling has gone entirely.

9.7.40. He is able to be up and walk to the toilet.

15.7.40. He is now up for 6 hours per day and able to walk over to the Massage Department for his exercises.
The Gonococcal Complement Fixation test is negative.

17.7.40. Discharged from the ward.

24.7.40. Reported as an out-patient. On examination there was no urethral discharge, both urines in the two glass test were clear. Prostatic examination revealed a normal prostate and vesicles. The secretion, expressed by massage, showed a normal cellular content with no organisms. There was no excess of synovial fluid in the knee joints and the quadriceps femoris muscles have regained their former size and tone. The Gonococcal Complement Fixation Test was negative. He was given permission to begin work on 5.8.40.

17.8.40. Reported as an out-patient. Feels very well and is able for his work. He has had no recurrence of any pain or stiffness of the joints. Nothing abnormal was found in the urinary examination and the Gonococcal Complement Fixation test was again negative. He was therefore discharged from the department.

Summary.

This case again illustrates the successful result obtained by artificial fever therapy given for acute gonorrhoeal arthritis to a patient who was co-operative in all stages of his treatment and conscientious in his "follow-up" attendance.
Chart of 2nd Treatment.
CONCLUSIONS.

The age-old conception that fever is a harmful process has given way to the modern knowledge that fever is a protective and defensive mechanism.

Observations on the thermal death time of the gonococcus and the clinical response of patients with gonococcal infections to artificial fever therapy, indicates that it is possible in most instances to destroy gonococci in the lesions of the disease, by the use of high sustained body temperature. In addition to this sterilising effect, there is evidence that artificial fever stimulates immune reactions.

The Inductotherm fever cabinet appears to satisfy the great desideratum in fever therapy, viz., to obtain and maintain a degree of fever which will actually kill or at least seriously retard growth of organisms in vivo and yet be essentially harmless to the tissue of the host.

Inductopyrexia is not entirely free from danger. The risk of serious complications developing during treatment may be lessened by a thorough clinical and laboratory examination of the patient before treatment and by regular observations on the temperature, pulse and blood pressure during a treatment. The laboratory examination should include an estimation of blood urea, radiograph of chest and electrocardiogram. The pulse rate and blood pressure readings are the simplest index/
index of efficiency of the cardio-vascular system during a treatment.

The results obtained on this series of patients suffering from Gonorrhoeal arthritis indicate that 66 per cent. of all cases are fit to return to work within an average of fourteen weeks. The failure of two cases to show any improvement is attributed to general asthenia and circulatory collapse which prevented a sufficiently high or prolonged pyrexia being obtained.

The prompt symptomatic relief obtained and the avoidance of crippling deformity, so often a feature of imperfectly treated gonorrhoeal arthritis, would appear to justify the expense of installation in large centres of an Inductotherm Fever Cabinet.

Compared with any other form of treatment for acute gonorrhoeal arthritis, inductopyrexia gives immediate and ultimate results which are excellent. This is particularly true if treatment is applied early.

It is evident that the longer the arthritis has existed, the more cartilaginous and bony changes there are, the less is the likelihood of relief from symptoms.

It appears to the writer that this method of treatment may be unhesitatingly recommended to those early cases who are physically fit and who are willing to undergo the slight discomfort of the treatment.
REFERENCES.


King/


