BURNS AND SCALDS
THEIR TREATMENT, PATHOLOGY
and
MORBID ANATOMY.

THESIS
Presented by
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For the Degree of
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Since my connection with the Liverpool Stanley hospital I have been struck by the fact that a large percentage of the casualties was made up of injuries due to burning or scalding. Situated as we are in the midst of a district densely populated by the poorer classes, this is perhaps to be expected; for the same care cannot be exercised over their children by working mothers as can be by mothers higher up in the social scale. Over 80% of our cases are children under 12 years of age, and in nearly every case there is a history that the accident happened while the child was unattended.

In 1909, 381 cases of burns and scalds were treated here, 87 of which were serious enough for treatment in the wards.

In 1910, 403 cases were treated, 60 in the wards.

In 1911, 474, 74, 87.

In 1912, 503, 87.

I considered a thesis on this common cause of
injury not out of place in view of the number of cases and the number of deaths due to it every year; and also from the fact that unless treatment be skilfully carried out a child even if it should survive; may be doomed to go through life handicapped by a hideous deformity.

In dealing with the subject I propose to treat it first in its clinical aspect. This will include the immediate treatment of shock, the treatment of the injury after the shock has passed off, complications, and the repair of the damage. After this I propose to discuss the Pathology and results of post mortem examinations.

DEFINITION.

A burn or scald is an injury to, or destruction of, tissue by heat; in a burn, dry; in a scald, moist heat. As the effect and treatment are similar, I will in future use the word "burn" in referring to both conditions.
CLASSIFICATION.

The simplest classification is that of Dupuytren, who divides them into 6 degrees.

1. Reddening of skin with no gross destruction.
2. Vesication.
3. Partial destruction of true skin.
4. Total destruction of true skin.
5. Charring of muscles.
6. Charring of bones.

As every burn exhibits examples of several degrees it is classified according to its most severe part.

The PROGNOSIS in cases of burning depends on several conditions in their order of importance; the area burnt, the part of the body burnt, the depth of the burnage of patient and to a certain extent the sex.

The AREA burnt is very important apart from the depth; for if half or more of the body area is burnt, even although only to the first degree, the result is almost invariably fatal. I say "almost," because
cases have been reported of recovery even when more than half the skin had been injured.

Dr. A. W. Barkly reports in the journal of the American medical Association, a case of an engineer, 56 years of age, scalded with steam and hot water. He had roughly 19 sq ft of skin, 10 sq ft of which were burnt, 6 sq ft to the 1st and 2nd degree, and 4 to the 3rd degree. He recovered without any contraction.

Recovery however in cases of such extensive injury is unfortunately rare.

Death in these cases is due to the profound shock due to the stimulation of large numbers of cutaneous nerves.

The PART of the body burnt is another very important point in Prognosis. Burns over the large serous cavities such as the chest and abdomen are more likely to cause death than if on the limbs.

Cases of burns in these positions exhibit shock out of all proportion to the extent of the injury, and are especi-
ially liable to inflammations of the serous cavities underneath.

The AGE of the patient as might be expected is an important factor in prognosis, the extremes of life giving the highest case mortality. This is mainly on account of the shock which is more marked in the very young and the very old; this period of shock successfully passed, children, unlike very old people, combat the other complications as well as those in the prime of life.

SEX seems to have a slight effect on the Prognosis; for the case mortality is higher in females than males.

The initial shock successfully passed, Prognosis depends to a large extent on the presence or absence of SEPSIS.

TREATMENT. A burn is an injury, and as in all injuries our first efforts must be directed towards the treatment of any SHOCK.

The cause of the shock in burns is the exhaustion of
the vital centres in the medulla from over stimulation by irritative impulses from the seat of injury and also on account of reflex inhibition from the psychic effect of pain and fright. The chief centres affected are the vasomotor centre and to a less extent the cardiac centre. The effect on the vasomotor centre is first shown by a fleeting constriction of the blood vessels with a rise in the blood pressure, which is followed quickly by a more lasting dilatation with a lowering of the blood pressure.

To prove that this effect was due to a loss of central control, Grile injected 2% solution of cocaine into the medulla of a healthy animal. The blood pressure at the time of injection was 115 m.m. and it immediately dropped to 50 m.m. That this loss could be brought about by paralysing the centre with repeated powerful stimuli, Grile showed by administering a series of injections of strychnine to a previously healthy animal.
He was able by these means to produce shock identical with that following injuries. In injuries due to burns we have a succession of exhausting stimuli from the seat of injury to the centres, and we can readily understand how the shock in these cases is produced.

The depressing effect of painful stimuli is shown by the fact that in burns of the 1st and 2nd degree the shock is relatively greater than in more severe burns; for in the former the nerve endings are stimulated while in the latter they are destroyed. The sooner these stimuli that are steadily exhausting the centre are cut off, the sooner will that centre recover, and the less profound will the shock be; so our first thought, in the treatment of shock, must be towards obtaining this result by relieving the pain. We must relieve the pain and secure complete rest mentally and physically.

In severe cases, nothing should be done to treat
the burn; for an anaesthetic is out of the question, and the pain of dressing the wound without anaesthesia would so exhaust the patient as to rob him of what otherwise might have been a chance of recovery.

The pulse, respiration and temperature should be carefully studied; and if from these the shock is judged to be profound, then the patient should be put to bed without even having his clothes removed, and every effort made to combat it by suitable means. Of course, it is only in the extreme cases that we need proceed to this extent.

In less severe cases, the injured parts may be quickly cleansed and a dressing applied, the best dressing being the Picric Acid solution which will be mentioned later. Any necessary handling of the patient should be done with the utmost gentleness, on account, as Keen points out, of the psychic effect of pain, and the production of dangerous shock-producing afferent
impulses which attend any manipulations of tissues having a nerve supply.

Having got the patient to bed, the foot of the bed should be raised so as to help mechanically a good supply of blood to the exhausted centres. The body heat should be kept up by the application of external heat in the form of hot bottles. Nor must this heat be applied without due care; for, if too much heat is applied, severe sweating will be produced, which will still further lower the blood pressure.

We must now direct our attention to the RELIEF OF PAIN. In severe cases of burns as long as he is allowed to lie quiet and the injured parts are not handled the patient does not feel much pain for he is too deeply shocked. In these cases sedative drugs are not needed. In less severe cases, where the shock is not so profound, and the pain is correspondingly more severe, I think some drug should be given for its relief, and in my opinion the best is Morphia.
I know that this is against most of the present teaching, and just lately the practice of giving Morphia for the relief of pain has been condemned by Lieber of the Lotheisson Clinique of Vienna. In spite of this, I still consider that the depressant effect of this pain on the sufferer and the restlessness by allowing him to toss about in pain is far greater than the depressant effect of the Morphia which relieves his pain.

In children, I give one-sixth of a grain hypodermically to start with and repeat in two hours if necessary. In adults, I have had no bad effects from the administration of one-third of a grain also repeated if necessary. In cases where a dressing can be applied, the pain is greatly relieved by this; so much so, that often an opiate is not needed in cases, which, before dressing, seemed to need it.

Having done all this, we must now attack our greatest difficulty, namely, the low BLOOD PRESSURE.
This I consider the most difficult and the most important part of the whole treatment of burns; for unless this difficulty is successfully overcome, the patient will not survive to require further treatment.

For a long time the cause of this low blood pressure, namely, the loss of peripheral resistance, was not recognised and general and cardiac stimulants were used. John Hunter first noticed in bleeding a patient for syncope that the blood flowing from the vein was bright red.

This was due to the dilatation of the capillaries and the arterial blood easily getting through into the veins.

The practice of giving STIMULANTS such as strychnine and brandy is still largely in vogue, and in all likelihood causes as many deaths as the shock itself.

As regards brandy, its effects are small and fleeting, and it has the same objections as strychnine, of which I will speak later. It also dilates the peripheral
vessels, and only aggravates the condition which we are endeavouring to improve.

The use of CARDIAC STIMULANTS has been lately advocated by Lieber, who lays a good deal of stress on their administration. While the blood pressure is so much below normal, I do not consider cardiac stimulants are permissible, and my argument is this.

There is a certain amount of exhaustion of the cardiac centre, but that all the weakness of the heart's action does not arise from this is shown by the fact that as the blood pressure rises the heart regains its strength. Now with the loss of peripheral resistance which is due to the dilatation of the capillaries, the heart has less work to do and I think that this seeming cardiac weakness is due to reflex inhibition of the heart's action, necessary to bring its power into accordance with the work it has to do.

On these assumptions I do not use cardiac stimulants, but focus my treatment on the raising of the blood pressure.
As regards strychnine I have carefully watched its effect in a series of 5 cases and compared them with a series in which it was not used but other methods of combating shock were. From these experiments I have convinced myself that more harm than good is done by strychnine.

Much work on this subject has been done by Mummery and embodied in his Hunterian Lectures of 1905; his belief is that strychnine stimulates the centres in the Medulla and gives a temporary benefit in cases of shock; but these centres having already been over stimulated not only can no good be done by further stimulation but real harm is probably inflicted on account of their subsequent profound depression. To quote Mummery's own words, "The administration of strychnine in shock is like beating a dying horse. It may call forth an effort if we beat hard enough but it hastens the end." This is in accordance with the experiment of Grile,
already recorded, who found that he could produce profound shock in a healthy animal by the repeated administration of strychnine.

Another danger of this drug which must not be overlooked is that repeated doses, to a shocked patient, tend to accumulate, and if the shock passes off a poisonous dose may be swept into the system.

It having been recognised that the administration of some drug which would act on the vessels themselves and cause a constriction would be nearer the ideal treatment, numbers of experiments have been carried out with this end in view.

Mummery experimented with adrenalin, and found that intravenous injection markedly raised the blood pressure but that the effect only lasted a very short time.

He found that to obtain a continuous effect it had to be given by continuous intravenous injection in very weak solutions 1 in 50,000 to 1 in 100,000.

He also experimented with ergot, and found its effect
more lasting than adrenalin.

Jacobi used a derivative of ergot which he called sphacelotoxin, and got the same good results.

Since then numerous experiments have been carried out with the extract of the posterior lobe of the pituitary gland.

All these experiments go to prove that the effect of this extract is to cause a vaso-constriction with a marked rise in blood pressure. This rise is greater and more prolonged than with other drugs, as is well shown in tracings taken by Kenneth Mackenzie when experimenting on the mechanism of milk secretion.

This rise is followed later by a fall, but the fall does not tend to go below what it was at the time of injection.

I used Adrenalin in a series of six cases, giving the 1 in 1000 solution hypodermically in doses of five minims to children and ten minims to adults, two hourly for the first twelve hours.
I did not obtain any good results from this as the rise in blood pressure was so small and fleeting.

Of my six cases, only one survived the shock of the burn.

More conclusive were my series of cases treated with Entract of Pituitary gland.

I used a patent preparation called Pituitrin each cubic centimetre of which equals .2 grm of fresh gland.

In children under 8 years I gave subcutaneous injections of from five to eight minims every 2 hours for the first 12 hours, and every four hours for the next twelve unless improvement took place. In adults I gave 17 minims at the same intervals. The effect of Pituitrin was much more marked and lasted longer than Adrenalin; and the fact that the former is a diuretic is also of advantage in the elimination of the toxins that are supposed to be formed in cases of burns.

Of the six cases which I compared with the six treated with Adrenalin, three recovered completely and one lived 3 days. Of the 6 treated with Adrenalin only...
I survived and 2 lived 56 hours.

Although this result is not very emphatic in favour of Pituitrin, from the small number of cases I believe this drug to be much the better of the two.

I tried Ergot in two cases, but both died within twelve hours of admission; as far as I could judge, the effect was neither very marked nor very lasting.

The injection of normal saline solution has been largely advocated in the treatment of shock, but before using it two classes of shock must be differentiated. One in which a large amount of fluid has been lost, and the other in which no fluid has been lost but the low blood pressure is due to an over dilatation of the vessels. But the shock of burns comes under the second heading. In these the arterial side is comparatively empty and the blood is collected on the venous side, and any addition of fluid to these already distended veins will still further embarrass the circulation without in any way affecting the cause. Also this extra fluid will
leave the vessels and invade the tissues, especially the lungs causing Oedema.

Grile has shown that after about 320 c.c of fluid per kilo. of the body weight has been injected, fluid escapes into the body tissues and causes Oedema.

Archard & Paisseau report a case of a woman suffering from severe shock who was treated by continuous subentaneous saline injection. 10 litres of fluid were injected in 24 hours. She died of Pulmonary oedema which they consider was directly due to the saline.

One case of mine showed this condition very well on post mortem examination.

He was a boy aged 1 8/12 yr, suffering from burns of right side of neck, chest, and abdomen to 1st degree, and right arm to 2nd degree.

He was given six rectal injections of six ounces each in the 3 days he lived, with 2 hourly feeds of two ounces milk and water.

- -18-
In spite of this the pulse became softer and faster and the respiration faster and shallower until his death on the third day.

At the post-mortem, his lungs, at the bases especially were found as sodden as a wet sponge.

In none of the other fatal cases, in which saline had not been given, was this condition found, and I believe it was due to adding this excess of fluid to tissues and vessels which already contained their normal amount.

The result of my observations of the treatment of the shock in burns has lead me to dispense with stimulants, such as Strychnine or brandy; not to give saline; but to use a drug which act locally on the vessels and causes a vaso-constriction.

The best of these drugs I believe to be Pituitrin administered hypodermically.

Interesting experiments have been carried out by Crile with a pneumatic suit which can be inflated so as to bring pressure to bear evenly on the cutaneous
vessels and so constrict them. Although I have not been able to try this, it would seem that a modification might be of use in burns of the chest and abdomen by enclosing the limbs in pneumatic jackets.

During the first twelve hours nothing in the way of nourishment need be given for absorption from the alimentary canal is practically arrested in severe shock. After this period efforts must be made to feed the patient by giving two hourly feeds of one ounce of milk with equal quantity of water. Usually this quantity is retained but if vomiting occurs the amount should be reduced for sometimes smaller quantities are retained and can be given at shorter intervals.

If unsuccessful in giving nourishment by mouth nutrient enemata should be employed. As the patient improves, the amount of water is reduced until pure milk is given with soft foods such as gruel or Benger's food.
The shock having been successfully treated, attention must now be directed towards the treatment of the wound itself. Generally speaking, the treatment should be to protect the wound until the damage is repaired. In the less severe cases this repair will be done by Nature, and we must so protect and treat the wound that the natural processes may go on under the most favourable circumstances.

When there is no raw surface, and the skin is just reddened as in burns of the 1st degree, we have to modify our dressing with the part of the body burnt. On all parts of the body except the face a solution of Picric acid is the best. The solution I use here is the following:

Recipe

<table>
<thead>
<tr>
<th>Ac. Picric</th>
<th>dr 1½</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol absol.</td>
<td>dr 3</td>
</tr>
<tr>
<td>Ag distillata</td>
<td>Fl. oz. 40</td>
</tr>
</tbody>
</table>
Lint is wrung out in this, applied to the burnt parts and covered with cotton wool. This is left on for 5-6 days, in burns of the first degree a second dressing not being necessary. On the face, on account of the staining of Picric acid, a greasy dressing, such as Eucalyptus ointment, will serve. This is the only case in which I allow a greasy dressing.

The old fashioned Carron oil treatment is now obsolete; for when the skin is unbroken, Picric solution is the best on account of its analgesic properties; when the skin is broken, an oily dressing only stops the discharge from escaping and prevents the wound from cleansing itself.

In burns of the 1st degree, after a few days the skin will regain its normal appearance to be followed later by some superficial desquamation.

Burns of the 2nd degree with vesication open up a field for argument as to the treatment of the blisters.
Unna stated that the fluid in then invariably contained organisms; perhaps on his authority, it was considered the proper treatment to cut away all blisters and to cleanse the surface underneath. Now the effects of a burn are those of inflammation, but here the irritant is heat and not an organism. There is dilatation of the vessels, with blood stasis, emigration of leucocytes and exudation of serum. In this way nature throws out defences against organismal invasion. At the same time, the fluid which bathes the raw tender surface underneath the protecting cuticle of the blister is a bland, non-irritating fluid isotonie with the body fluids and possessing bactericidal powers on account of the leucocytes in it. It would seem impossible to improve on this unless the fluid of the blister were full of deleterious organisms.

To settle this point I took specimens of the fluid in thirty cases and tried, in the ordinary media, to cultivate an organism.
My method of withdrawal was to sterilise a small part of a blister with iodine and then with a sterile syringe to puncture and draw off the fluid. In only one case of the thirty was I able to obtain a growth. I have taken fluid from blisters within ten minutes of burning and from others as long as three days.

Encouraged by this observation I instructed the nurses not to puncture the blisters but to dress them entirely with the Picric acid solution. The result of this clinical test was highly satisfactory, as in every case healing took place under the blister more quickly and less painfully than if the raised cuticle had been cut away. It is evident that with the blister unpunctured and no raw surface exposed there is less chance of septic infection.

My experience supports that of Lejeune of Frankfurt who believes that the heat of the burn is enough to disinfect the tissues and the exuding fluid is sterile.
We injects into the blister some bismuth emulsion through a syringe and, when this has settled so as to cover the raw surface, he draws off the fluid and allows the raised cuticle to settle down on to the bismuth. He says with this method he gets healing quicker and with less scarring or Pigmentation.

If however, the blister has burst and the cuticle is hanging in shreds then this should be removed and the surface gently sponged with the Picric solution a dressing of the same solution being applied. This dressing is left on for 5-6 days on removal the usual thing being to see a healthy surface practically covered with epithelium.

In all cases of greater severity our main line of treatment after that of shock must be to relieve pain, to guard against sepsis and to help repair. There are many different methods each more or less efficient, so that the choice of one method in preference to another is often determined by the simplicity of that method.
Before discussing different methods I will state the one which my experience here has led me to adopt. A very important thing is to get the wound as clean as possible as early as possible. When the shock is great we cannot pay much attention to the wound but must reserve treatment until the shock has passed off when we should endeavour to give the wound a thorough cleansing. In extensive cases an anaesthetic should be given and the whole surface scrubbed with Hydrogen per-oxide. This should be thoroughly done, for if the initial cleansing is thorough, the future treatment is simple. After this cleansing, the wound should be dressed with lint wrung out in the Picric solution. This dressing may be left safely for 4 - 5 days.

This method, if carried out, gives splendid results the percentage of cases going septic being very small.

In some hospitals the immersion method is used, in extensive burns the patient lying slung in the bath with all the wounds covered.
The solutions used are normal saline or Acid Boric or Sodium bi-carbonate of a strength of a dram to the pint. This method is often very soothing to the patient and it has the additional advantage that he can be kept at an equable temperature, but I do not think the antiseptic and cleansing effects are very great. For the antiseptic strength is too small to kill any infection and there is not enough mechanical cleansing. The wound wants both a scrubbing and flushing not merely a bathing of the outside layers. Besides this the method is cumbersome and requires special apparatus and a great deal of attention.

W.L. Ester first washes the surface of the burns with 2% Carbolic acid or 5% Creolin and then washes with normal saline and as a first dressing uses normal saline or 1% Potassium or Sodium bi-carbonate.

Gray of Aberdeen first cleanses thoroughly employing an anaesthetic if necessary, and then dusts with a powder consisting of equal parts of Boric Acid
and Bismuth carbonate. The sub-nitrate of Bismuth must not be used as it causes intense pain. This powder forms with the exudation from the wound a scab which protects the part from fresh infection.

If swelling takes place under the first scab, this should be removed and the part again dusted but Gray says he has never had to remove a scab. He says he gets a pliable scar, little or no contraction and a very vascular cicatrix.

J. F. Alexander (Medical Press and Circular 31/1/12) carried out experiments in 27 simultaneous cases of burning. He treated 7 cases of 1st 2nd & 3rd degrees with Boric baths keeping them in the bath for from 2 - 6 hours with the same interval between the baths. On 7 cases of the 1st 2nd and 3rd degrees Picric acid solution was used the lint being covered with oiled paper. In spite of large areas being treated in this way he says he had no symptoms of poisoning though several patients showed signs of
the absorption of the acid by passing dark urine a condition which cleared up on the administration of Magnesium sulphate.

Five cases of 2nd and 3rd degrees he treated with Carron oil; five cases of the same degrees with Unguentine; the rest with an ointment made up of Ichthyl; grains 48, olive oil, drams 2, and Lanoline to make three ounces. He spread this on gauze and covered with oiled paper. All the cases were first washed up with soap and water and cleansed with Hydrogen peroxide.

We concluded that Picric acid dressings were by far the best in burns of the 1st & 2nd degrees and Boric acid baths in the more severe cases.

In four cases he had duodenal ulcer with severe haemorrhage, but all recovered on a strictly fluid diet Lieber swabs gently with benzene, and then applies a dry mildly antiseptic dressing in the form of nowiodine powder, covered with gauze. This dressing
is renewed in two days.

In cases that can be taken into hospital and given an anaesthetic to permit a thorough cleansing of the wound, I believe that a powder dressing is a simple and efficient one in affording protection and preventing sepsis. It can be made to relieve pain if we use some analgesic powder such as Anaesthesia. But in extensive burns it is difficult to get the whole surface aseptic, and suppuration beneath a powder dressing is attended with undesirable results. In out-patient cases, in which an anaesthetic is not given, and which are too painful to allow of the necessary scrubbing, powder dressings are out of the question.

In the out-patient department, as in the hospital my great stand-by is the Picric Acid solution. The application of this dressing is so soothing that children who come in screaming with pain stop crying and the older ones will testify that the pain is much better.

Ehrenfried testing on B. Pyocyaneus and Staphylococcus aureus found a saturated aqueus.
solution of Picric Acid more lethal than 1% Phenol

The solution of Picric acid is also to some extent a deodorant. Therefore in this solution we have an antiseptic, analgesic deodorant dressing which also appears to stimulate the growth of epithelium and thereby favour repair.

The risks of poisoning are small if it be used as a dry dressing and changed every 3-5 days. In fact although Dr. J.F. Alexander soaks gauze, in the solution and covers it with waterproof he reports (vide ante) that he had no cases of toxic poisoning and that only in a few cases did the urine become darkened.

In young children where the absorptive powers of the skin are very great, I think the practice of covering with waterproof is very risky except where the surface covered is small.

In one case which I saw in private, a child of fifteen months had been treated in this way for burns of the chest and arm and she died on the fourth day with all the symptoms of picric acid poisoning.-31-
The symptoms of poisoning are gastric and intestinal irritation, with vomiting and diarrhoea, headache and sometimes delirium.

The skin and conjunctiva show a yellowish staining.

The urine is a dark red or brown, and Micturition is often frequent and painful.

Very few fatal cases of poisoning have been reported and none so far as I can ascertain where the solution was used as a dry dressing. Powders containing Picric acid are dangerous on account of the amount they contain.

Mr J.A. Mitchell, (South African Medical Record July 1912) reports one fatal case in a child 1½ year burnt on the foot with boiling fat. The parents had used a patent dusting powder containing 17% Picric Acid in Boric acid powder. This was dusted on for fourteen days prior to the child being taken to hospital.

On admission the conjunctiva and skin were yellowish, the urine was brown and the micturition frequent and painful.
The pulse varied from 100 - 150. There was vomiting and also diarrhoea with yellow slimy motions. Later a general erythematous rash appeared. The child became stuporous and died 22 days after the accident.

I had an interesting case under me of a girl of 12 years with extensive burns of the thigh and labia to the 3rd degree. These were dressed with lint soaked in the Picric solution which had to be changed frequently on account of the position of the injury. On the fourth day she complained of feeling sick, and her Urine was noticed to be a greenish brown colour. She had no rash, and her sick feeling and the colour of her Urine were the only indications of poisoning. The dressing was immediately changed to one of a weak solution of Lysol, and she was given an ounce of Magnesium sulphate. The next day she felt quite well, and in two days the urine was normal. This is the only case I have had of picric acid poisoning.

In burns where the whole thickness of the skin
is destroyed, growth of epithelium to cover the raw surface can only take place from the edges of the wound. Where the area is small, this will be sufficient, and we need only keep the wound clean so that this growth may go on under the most favourable conditions. In connection with this the cosmetic effect must be considered, for a slow healing from the edges is followed by a depressed puckered cicatrix. Therefore on exposed parts and in the vicinity of joints, even although we know that in time the epithelium from the edges will grow in and cover the raw surface, we must endeavour to bring the surface into a condition for skingrafting as soon as possible. The sooner we get it covered with epithelium the less subsequent contraction will we have. In places where this is not so important, and we decide to let the epithelium from the edges grow in and cover the gap we can by suitable dressings stimulate this growth.
In connection with this I would emphasise the great benefit of a change of dressing. After one kind of dressing has been used for some time the wound gets into a stationary condition, and the epithelium seems to have reached its limit of growth. A change of dressing will impart new vigour to it.

A large number of the out-patient cases are cases of this sort, and many are in addition infected on account of dirt getting in through bandages slipping or being removed by parents anxious to see how the wound is progressing.

Any sepsis present must first be treated and the wound brought into the condition of a healthy healing sore. Most of them clean up in a day or two with the Picric acid dressing, and in this condition, where the area of the wound is small, I often alternate in this way; one day using picric acid covered with waterproof and the next two days using it as a dry dressing.
In small burns one or two good spongings with Hydrogen per-oxide is very effectual.

A very good dressing where there is sepsis with a copious discharge is Wrights dressing, which consists of a sterile aqueous solution of 4% sodium chloride and 1% sodium citrate. It is applied as a wet dressing and is useful in out-patients where the dressing cannot be frequently changed. Its osmotic power creates a flow from the wound into the dressings, and the sodium citrate prevents coagulation of the discharges.

In obstinate septic cases I have great faith in charcoal poultices on account of their cleansing and deodourant effect.

Having obtained a clean surface I treat it with the picric acid solution until it reaches the stationary stage when I change to some other dressing. An old and tried favourite is red lotion.

I have also tried a saturated aqueous solution of
Allantoin with very good results.

This substance, which is found in the foetal allantoic fluid and in the urine of pregnant women, is supposed to be a cell proliferant and also a cleanser of sloughing surfaces (B.M.J. 1/12. 102)

The first case I tried with allantoin was a woman who was attending the out-patient department with the whole of her right arm burnt to the 3rd degree. She was a person whose ideas of cleanliness were of the most rudimentary order and at the end of the first week the whole surface of the wound was infected and discharging freely. On account of this I changed from Picric acid to allantoin, using it as a wet dressing after the manner of Wrights. Its effect was astonishing. Three days after the first dressing, the dressing being changed daily, the wound was much cleaner, and a great part of the raw surface covered with epithelium. At the end of a week very little remained unhealed and
this I expect was completed with the last dressing for the woman did not return.

W. Lothrop (America) in slowly healing cases uses a mixture of Ichthyl, Balsam of Peru, and vaseline, and in cases still more refractory, Resin ointment.

In burns of greater severity with destruction of more or less subcutaneous tissue I sponge well with the Picric solution and apply a dressing of it which is changed on the 3rd day. By this time the dead tissue will have formed hard, dry eschars. These should be cut away as soon as possible for as long as they remain they form a good nidus for infection and are a constant source of danger. If they are very extensive and tough a good plan is to cut into them in different directions to allow the antiseptic to penetrate, this not only helping to keep them sweet but also tending to loosen them. The time of greatest danger of sepsis is from the time of injury to the separation of the sloughs and the formation of a granulating surface, for a
granulating surface is essentially an exuding not an absorbing surface.

Having got the wound clear of sloughs and the surface into a suitable condition, we must proceed to cover the surface with skin grafts. The skin can usually be obtained from the patient, and the method used may be either Reverdin or Thiersch. In all my cases except one, I have used the latter method, as it is simpler and leaves a very superficial and rapidly healing wound. If possible, the grafts are taken from the inner side of the thigh or the upper arm as here the skin is soft and pliable and has few hairs. The area to be used is rendered aseptic by well scrubbing with soap and water and washing over with normal saline. Strong antiseptics should not be used in preparing the skin as they tend to lower the vitality of the grafts.

All my cases, excepting the very young children, I have done with local anaesthesia.
A ½% sterile aqueous solution of Novocaine injected under the skin in the following manner.

The needle is introduced as high up the thigh as I intend to cut the grafts and the area infiltrated as far as the needle will reach. Then I proceed to infiltrate in a straight line parallel with the long axis of the limb each time introducing the needle through the skin anaesthetised by the previous puncture.

In this way three or four lines parallel to one another and about 1" apart are made, the patient only feeling the prick of the first puncture. The skin in between the lines is quite anaesthetic. The grafts are cut in the usual way and transferred to the area to be covered, the grafts overlapping one another and the edges of the wound. One great advantage of a local anaesthetic is that the patient can turn about into the best positions, and the dressings are less likely to be disturbed and the grafts displaced if the patient is not lifted about. The grafts are covered with perforated green protective and dry gauze, and the
dressing is left undisturbed for five to seven days. Instead of putting dry gauze over the protective, I have wrung the gauze out in the allantoin solution. This I think helps the grafts to take better and to grow quicker than when the dry gauze is used (B.M.J.1/12.10). The place from which the grafts have been taken can be dressed with any dressing, the one I use being the picric solution such as is used on the burns.

The Reverdin method presents advantages in the cases where there is a lot of exudation from the surface. The skin is picked up on the point of a needle and the piece snipped off with scissors. This is cut up into pieces the size of a Pinhead, and planted over the surface within a quarter inch of one another. The after treatment is the same as before. A clean foreskin will do very well for this method.

In the vicinity of joints movements must be started as soon as the new skin is strong enough to stand a little strain. These movements at first should be very gentle and very limited; and later they should be
Combined with massage.

By manipulation of this kind it is remarkable how much movement can be regained in a joint which seemed hopelessly crippled.

**Complications**

There are certain complications in cases of burning which are liable to arise more frequently than in other surgical cases.

Among these I will include the toxaemia, which in a great many cases is the cause of death in the first five or six days and which in all excepting the most trivial cases is a constant cause of anxiety.

I will discuss the source of this toxin later; the generally accepted view is that the action of heat on the tissues forms poisonous substances the nature and composition of which are unknown. These are absorbed into the bloodstream and act as powerful poisons.

During the initial stage of shock, the symptoms of toxaemia, if such is really present, are masked so that usually they are not noticed until after the 2nd day.
Then suddenly the temperature rises to 101° or 102°. The pulse becomes rapid and the breathing rapid and shallow. The next time the temperature is taken it will most likely be down a degree or two only to rise again higher with the pulse and respiration also increased. Therefore as soon as we have tided the patient over the shock we should prepare to treat the toxaemia. Accepting the theory that we have a soluble non-bacterial poison circulating in the blood, the sooner we get the system clear of it the better.

One naturally turns to the excretory organs, and it is of the utmost importance to obtain a free action of them.

My principle, roughly, is to put fluid in, let it circulate in its path absorbing some of the toxin then to help its excretion hoping that it will bring some of the toxin with it.

It is at this stage that I think the injection of normal saline is useful. In children it will usually be most convenient to give the saline per rectum.
4-5 ounces every 4 hours; in adults it may be given by continuous subcutaneous at the rate of ½ pint per hour or continuous rectal 1 pint per hour.

The patient should be encouraged to take plenty of bland fluid per mouth such as milk and water or barley water, and some simple diuretic and diaphoretic mixture should be administered. The one I use here is

Recipe

\[
\begin{align*}
\text{liq Ammon acetat} & \quad \text{dr 1} \\
\text{Sp aether nit} & \quad \text{dr ½} \\
\text{Potass. citrar} & \quad \text{gr 10} \\
\text{Syrup aurant} & \quad \text{dr ½} \\
\text{Infus scoparii} & \quad \text{ad Fl. oz. ½}
\end{align*}
\]

This should be given every four hours.

Heyde (Medizinische Klinik Berlin 18/2/12) says there are many mysteriously fatal results after about the twelfth or fifteenth day.

Patients have progressed favourably up to this time, and have then suddenly succumbed with phenomena for which no explanation can be found on post-mortem examination. He had a number of these cases.
especially in children. They were doing well when
suddenly the temperature dropped and they died in
convulsions and delirium. He thinks these fatal results
are due to anaphylaxis induced by absorption from the
burnt tissues of substances which act as antigens. The
reason of the delay is that after a period of absorption
the body becomes sensitised to them and any further
dose is fatal.

He says similar phenomena can be produced in animals by
inflicting a small burn, or by re-implanting some of
their tissues which have been removed and burnt outside.
The animals die with symptoms of hyper-susceptibility
although the tissues implanted or the injection are
harmless. He thinks it wise to remove the burnt tissue
more thoroughly than has been done hitherto.

In many cases pulmonary complications arise
especially in burns of the chest.
These are heralded by a rise of temperature and by
disturbance of the pulse and respiration.
Bronchitis is the commonest condition, and many who survive the shock and toxaemia develop bronchitis. In a few cases a pneumonia develops secondary to the bronchitis; this however is a rare event for although many of my cases developed a bronchitis only one went on to pneumonia.

The bronchitis should be treated by any of the stimulating expectorants, and it is important to treat it early. The occurrence of bronchitis in very extensive burns is to be feared on account of the difficulty in giving an anaesthetic for the dressing.

Pleurisy is liable to occur in burns over the chest. In one case which died some weeks after admission I found a well marked patch of pleurisy corresponding to a large burnt area on the outside.

Burns about the head are said to cause Meningitis and burns on the abdomen to cause Enteritis, but I have had no cases presenting these complications.

Duodenal Ulcer is a complication which must be borne in mind as it occurs in a fair number of cases.
and occasionally causes death. Although my pathological specimens support the view that the duodenal mucous membrane is liable to degenerative changes I have never had a case of actual ulcer. Nor am I able to record a case of ruptured duodenal ulcer in eighty seven cases which were serious enough for admission to hospital and which were under my care.

As there is abundant evidence of ulceration of some part of the intestinal tract, whether it be in the duodenum or in the lymphoid tissue lower down, it is well to regulate the diet in all cases of burns.

In many reported cases there has been severe haemorrhage but the cases recovered on being kept on a strictly fluid diet.

Oedema of the glottis is mentioned as a dangerous complication likely to arise in burns of the neck, but in 15 cases I have had with burns in this position there has been no sign of this complication.

Most of Dr Alexander's cases, quoted before, were burnt.
about the face and neck in escaping from a building but in none did any symptoms of oedema of the glottis arise.

Remote effects

The commonest result of a burn is of course deformity; fearful examples of this are still to be seen, but are getting rarer as the result of better treatment and skingrafting. The deformity is caused by the contraction of the fibrous tissue formed in the scar; although we can do much to lessen the degree of fibrosis, in all but burns of the first and second degree there is a certain amount of fibrous tissue formed.

By the use of better aseptic methods, fewer of our burns now go septic and on this account heal more quickly and leave a better scar. A further improvement has been effected; for instead of allowing a wound to go on contracting until the skin edges are brought together and it is healed, we cut short the process by skingrafting.
The most obvious deformities are those situated on the exposed parts, especially the face. The eyelids and lips are often everted or pulled into grotesque shapes. These deformities have to be met by suitable plastic operations.

Another common deformity results from burns about the neck, the chin being drawn down and even becoming adherent to the front of the chest. This can be improved considerably by skin incisions, and by division of the contracting bands of fibrous tissue followed by skin grafting the raw surfaces.

Deformities due to contraction of scars in the vicinity of joints are very common and especially so in the shoulder and elbow.

Burns in the axilla are apt to be followed by great limitation of movement unless the greatest care is taken and early resort made to skin grafting. The commonest result is for the upper arm to become united to the chest wall to a greater or less extent. A great help in these cases is the skin which is usually
left intact at the apex of the axilla for if this part is raw, like the analogous part in the cure of syndactylism, it is the hardest part to prevent joining.

The principles of treatment of burns around joints are: prevention of sepsis; the promotion of early healing, especially by skin grafting; early recourse to massage and gentle movement. During healing in order to combat the tendency to flexion it is advisable to keep the joint extended on a splint.

A fairly common complication is the development of a keloid condition. In many this is more of the nature of a hypertrophied scar than a true keloid. I have had several cases under me in this hospital and the treatment is most unsatisfactory. If not on exposed parts and if not tending to spread the best treatment is to leave it alone. Excision is useless as it only recurs in the scars worse than before. I have tried injection of fibrolysin but have not been
been able to detect the slightest benefit.

X-ray treatment has been recommended for large keloids but it has to be used over a long series of exposures. For small keloids the best treatment is the application of CO$_2$ snow.

Mr R W Murray (Liverpool Medico-chirurgical Journal July 1912) reports a peculiar condition of the ears affecting persons after severe burns received in the explosion in Bibbys oil cake works. Four to five weeks after the accident, when apparently healed, sudden swelling of both ears occurred. There was no pain, but the onset in a few cases was heralded by tingling. Incision into the swelling let only a little serum escape.

The cartilage did not exfoliate but simply disappeared. Hearing was not affected. The burns of the ears had been treated the same as the other parts.

Mr Murray believes the condition to be due to some nervous case.

Dr Emil Vogt of Dresden reports an interesting case (B M J 30/12/11) In June, 1908, 6 weeks after
weaning a child, a woman was burnt to the fourth degree on one breast. At the time the burn was received, milk secretion had stopped and the menses had returned. Immediately after the burn a profuse secretion of milk set in and the menses stopped. Grafting was done, but the wound was not entirely covered in until fourteen months after. During all this time there had been galactorrhoea and suppression of menses. Directly the wound had healed milk secretion stopped and two days later the periods returned.

SHORT SUMMARY OF TREATMENT.

To sum up, the conclusions which I have formed as a result of carefully watching cases and testing different methods of treatment are:

If a severe case, neglect everything else and treat the shock not by stimulants as strychnine or alcohol which stimulate the already over-stimulated and jaded centres, nor by the injection of saline into the already over distended veins but by the injection
of pituitrin which acts as a vaso-constrictor. This by acting directly on the dilated vessels, causes them to contract; this vaso-constriction by raising the blood pressure stimulates the heart by giving it more work to do.

Do not use cardiac stimulants as they are unnecessary.

As pain is a great cause of the continuance of shock, relieve it by morphia rather than allow the patient to further distress himself by restless suffering.

Apply external warmth and keep the patient as quiet as possible.

When the shock has passed off treat the burn itself. Give an anaesthetic if necessary and cleanse the surface well with hydrogen peroxide, afterwards applying as a dry dressing the Picric acid solution, which is an antiseptic analgesic, deodourant and epithelial stimulant.

Do not open any blisters, as in the great majority of cases they do not become septic but form a
protecting non-irritating dressing to the raw surface beneath.

During the first few days treat any toxaemia which is present. Treat this by the administration of fluids by mouth or by injections of normal saline. Keep the skin and kidneys acting freely by the administration of some mild diuretic and diaphoretic mixture.

Be very careful to keep the wound aseptic as the whole course of the case may depend on the presence or absence of infection.

Skin graft as soon as possible to minimise the deformity and when the wound is in the vicinity of a joint start movements and massage as soon as possible.

Treat the complications as they arise.

PATHOLOGY

Among cases of burning which survive the initial shock are many which prove fatal for reasons at present unknown. Where the area of skin burnt is extensive, it may be due to a toxaemia resulting from the stoppage of the skin functions and non-elimination of products of
metabolism normally excreted by that system.

A more generally accepted view is that the action of the heat on the tissues results in the formation of highly toxic albuminoid substances.

These two theories claim in common that the fatal result is due to a non-bacterial toxaemia, the source of the toxin however being different.

Another view which must be considered is that of infection of the wound by Pyogenic organisms which set up a toxaemia or even provoke a Septicaemia.

The question arises. How soon can we get a bacterial toxaemia or septicaemia?

When we consider the large surface of a burn on which organisms can grow under the most favourable conditions, it is not hard to believe that an amount of toxin sufficient to cause a severe toxaemia could be elaborated in a very short time.

Thus we have three possible sources of a toxin. The diminished action of the skin although a possible cause is not very probable; for in some cases where we
get a severe toxaemic condition there is still a large surface of skin to carry on the functions, and it is sometimes absent even when the burns are extensive.

The theory that the toxin arises from the action of heat on the tissues is open to the objections stated above.

I have carefully watched a number of cases which, though not all fatal, all showed clinically the same condition. In each of the 13 cases in which there were symptoms of a toxaemia there was infection of the wound, and all showed a leucocytosis varying from 16,000 to 31,000. In one case which died on the fourth day, I cultured from the heart blood and obtained an abundant growth of a micrococcus very like staphylococcus aureus but not giving such a definite orange yellow growth on agar. A culture from the deep surface of the wound in this case also gave the same organism. In another case which died on the 3rd day I was also able to grow a staphylococcus from the heart blood.
In three other cases which lived longer, and which since the second day had exhibited a swinging temperature, I was able to obtain from the heart blood a growth, in one a staphylococcus, and in the other two a streptococcus.

An interesting comparison was made between two cases which were admitted within a few days of one another suffering from very similar injuries. In one, the blisters had burst under the clothing and the surface was very dirty. In the other, the blisters were intact and were dressed unpunctured.

On the fourth day the former began to run a temperature which fluctuated between 99° and 102° for several days. The wound looked dirty and was discharging freely; there was a leukocytosis of 31,000, mainly polymorphs. Thorough and frequent cleansing of the wound with Hydrogen peroxide with frequent changing of dressing resulted in a marked improvement and a drop in the temperature.

The other case which had no raw surface to get infected and which healed without the blisters bursting.
had a slight rise of temperature to 99.2° on the third day after which the temperature kept at or near normal.

These observations lead me to think that a certain degree of toxaemia arises from poisons due to the destruction of tissue, but that the profounder toxaemic conditions are due to bacterial infection of the wound. Sections of the organs in fatal cases show conditions quite in accordance with the theory of a toxin, and clinical observations support the view of its bacterial origin. All the sections which I cut showed a hyperaemic condition of the organs. The liver and kidneys presented cloudy swelling and in some cases fatty degeneration. The spleen was enlarged softened full of blood and crowded with lymphocytes.

In one case, where the patient survived for a week, there were soft vegetations on the tricuspid and mitral valves.

As regards the changes in the intestine and the possibility of ulceration, my section support the belief that degenerative changes do take place.
I examined macroscopically and microscopically the intestines of ten fatal cases. In none of the cases was there naked eye evidence of ulceration in any part of the intestine.

In seven of the cases there was redness of the mucous membrane of the duodenum, and in these cases the Peyer's patches of the ileum were congested and prominent while the peritoneum covering them was also markedly engorged. Microscopically the duodenum in these cases showed a degeneration in the lining cells of the glands, the nuclei staining badly, and the cell substance being slightly granular. In two cases there was some shedding of the surface epithelium with a small-celled infiltration of the submucous tissue. Whether this was actual ulceration or an artefact I am not prepared to state definitely, but am inclined to believe the latter the correct interpretation. The Peyers patches in all the cases showed a well marked small-celled infiltration and in two cases there was breaking down in the centre.
Three of the ten cases showed no abnormal conditions. It would therefore appear that the Peyers patches are more liable to ulceration than is the duodenum.

NOTES OF SOME INTERESTING CASES.

1. J. D., male, aged 43. The whole of left arm to wrist burnt to 4th degree. The left shoulder with the left scapular region and the left side of front of chest down to nipple to within one inch of middle line to same degree.

The whole of the axilla including the apex to 4th degree.

He suffered a moderate amount of shock but recovered without any special treatment. In spite of two dressings with Picric acid in the first six days the wound became septic.

Boric acid baths and fomentations were used for three weeks from this date but without much benefit.

Charcoal poultices were then used four hourly for three days when the wound was clean.

He was now given a general anaesthetic and grafts were
taken from the left thigh sufficient to cover the whole of the forearm. The operator in this case was rather unskilled in the cutting of Thiersch graft, and in some parts had taken the whole thickness of the skin with some of the superficial fascia. Notwithstanding the thickness of the grafts, the majority took, a curious condition setting in a few weeks later. Right round the wrist where the thickest grafts had been placed a thickening developed which seemed to be in the grafts themselves. This contracted and the constriction caused in the hand a marked oedema which persisted for weeks. This thickening may have been a peloid condition for on the thigh from where these grafts had been taken there was a well-marked peloid growth.

The next grafting was done three weeks after the first a local anaesthetic of ½% novocaine being used, and the area from the elbow to the shoulder including the axilla covered in. All the grafts took except those over the point of the elbow and in the axilla.

Two weeks later (again under local anaesthetic) grafts
were similarly taken from the thigh and the remaining raw surface covered.

On account of the awkward position for bandaging and the risk of the grafts being rubbed off, the open method was used, the area being protected by a cradle. This did not give such good results, as the grafts adhered to one another in places preventing the escape of the abundant exudation which lifted them up like the cuticle in blisters. Notwithstanding frequent puncturing the majority of the grafts died.

Just at this time there were a number of clean circumcisions in the out patient department; I was therefore enabled to secure a number of foreskins which I cup up as fine as possible and planted over the surface. They were dressed with perforated green protective covered with aseptic gauze soaked in a saturated solution of allantoin. All these took splendidly and the remaining raw surface was covered in.

These foreskins do not need to be transferred directly to the area to be grafted; but will retain their...
vitality quite well for 24 hours if kept in normal saline
at a temperature of 40°, it was observed that keloid
only developed in the places from where the thick
grafts were taken, there being no sign of it after
ordinary thin Thiersch graft.

2. N. B., female, aged 4 years.

This case shows the remarkable way in which some
children will rally from profound shock and withstand
prolonged suppuration.

She was admitted suffering from burns of all the right
arm, left upper arm, front and sides of neck up to the
ears and lips, all the front of chest down to umbilicus
round to the left scapular region, practically all the
area being burnt to the 4th degree.

The right thigh was burnt to 3rd degree. The case was
considered hopeless. As the clothes were nearly all
burnt off the remainder were cut off and a Picric
dressing applied. The temperature was 96° pulse
imperceptible; respirations 40, and very shallow.

She was given 1/2 S. C. of pituitrin every 3 hours for 16
hours; next morning the temperature was 101°, with pulse 80, respirations 36, and fairly strong.

Next morning, the temperature was 102 with Pulse 140 and Respirations 40. She seemed much worse and lay in bed practically comatose. She was given 2 hourly feeds of two ounces milk and water, and rectal salines of six ounces with one dram of brandy every 4 hours. These were continued for two days, that is, up to the end of the 4th day. The temperature gradually rose with slight remissions until the 6th day when it was 103°, with pulse 160 and Respirations 40. Then the temperature fell rapidly reaching normal on the 10th day, where it continued for 14 days

The thigh remained clean, but the other raw surfaces were infected and discharged freely. The wounds were dressed every 3 - 4 days under an anaesthetic, and every effort made to cleanse them. In spite of unremitting attention she died on the 48th day after the injury.

At the last dressing two days before she died all the surface had dried and become glazed, the ribs and
cartilages projecting through devoid of covering.

Bed sores had formed over the Sacrum and vertebral column, in two places the spines of the vertebrae being bare.

In the abdominal wall of her right side a fluctuating swelling the size of a hen's egg had formed.

**POST-MORTEM.** It was observed that whereas both arms and the right leg the parts which were burnt, were practically fleshless, the left leg which was uninjured was very little wasted.

On the left side the Pleura was slightly adherent.

Both lungs showed extensive broncho-Pneumonia.

There were extensive soft vegetations on mitral valve.

The liver, spleen and kidney were congested. The Duodenum was red and congested but presented no sign of ulceration. The Peyer's patches were congested and prominent.

In other respects the intestine looked normal.

The swelling in the abdominal wall contained yellow pus. On culture this showed a staphylococcus. The same organism was obtained from culture of the heart blood and the deep layers of the burnt part.
It is significant that all three cultures gave the same organism a fact which pointed to the presence of Pyaemia with a metastasis in the abdominal wall.

Sections of the liver, spleen, pancreas, kidney, duodenum, Peyers patches, and heart, were cut and examined microscopically. All showed marked fatty degeneration.

There was no ulceration in the duodenum or Peyers patches but the lining cells showed degenerative changes.

3. D. J., male 1 3/2 yrs. This case was one of the early cases which were treated, during the stage of shock, with saline injections and stimulants.

He was admitted with burns of chin, right side of neck, right arm from shoulder to finger tips about half of the area to 1st degree the rest to 2nd degree.

Right side of chest and abdomen to 1st degree.

On admission the temperature was 96.6° with Pulse 120, and Respiration 20. He was given a hypo of Strychnine grain 1/20 and rectal salines of six ounces with one dram brandy every 4 hours for 24 hours.
His temperature rose to normal at the end of 48 hours, but the pulse and respirations increased in rapidity. At the end of 60 hours the temperature had risen to 101.4°. On the morning of the 3rd day the temperature rose to 103.2° with Pulse 156 and Respiration 44. He died that night.

POST MORTEM. Pleura not adherent. Both lungs were very oedematous and were just like wet sponges. The right side of the heart was engorged with blood and all the cavities containing large ante-mortem clots. The Spleen was dark red and very friable, almost diffluent.

The Duodenum was red and congested. There were no signs of ulceration.

The Peyer's patches were very red and prominent. The peritoneal coat of the bowel covering the patches was red and congested.

The Liver and Kidneys were congested.

Sections were cut of these organs and showed the following changes.
SPLEEN. Engorged with blood. Large numbers of lymphocytes; small areas of necrosis.

KIDNEYS Marked cloudy swelling of cells of cortex and cells lining tubules. Some desquamation of cells of tubules.

DUODENUM. The surface epithelium showed degenerative changes and in several places the cells were absent.

PLEYERS patches. Marked engorgement of the vessels.

In two places of the section there were areas of small celled infiltration & breaking down in the centre of one.

Liver and Pancreas showed cloudy swelling.

A culture of the heart blood was made and gave an abundant growth of staphylococcus aureus.