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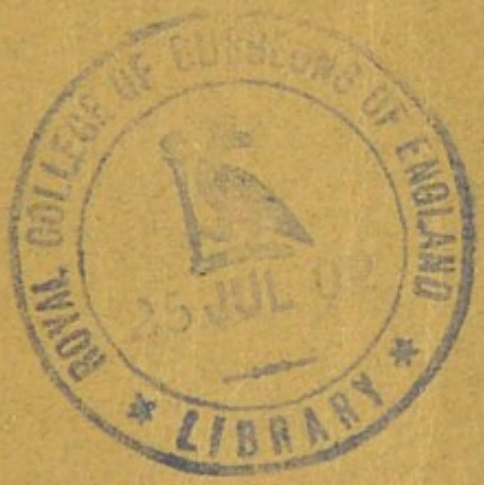

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A STUDY OF BURNS, WITH A PLEA FOR THEIR MORE RATIONAL TREATMENT.

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THIS article is written to arouse interest in a class of surgical injuries which the writer believes are neglected.

The reaction of the body to high degrees of heat in the form of flame or molten metal, boiling fluid, escharotics or electricity, resulting in injuries varying in severity, is the cause of their desultory treatment.

Burns and scalds are the commonest injuries of the body and Holmes ranks them as the most commonly fatal; Cheever of Harvard state that more than three-fourths of all burns occur in children; this I consider too sweeping a statement, although that of one-third to one-half of all deaths given as occurring in the young may well be accepted: A burned child has less vitality to combat such injuries than a grown person and will, therefore, more often succumb.

Of predisposing causes winter months and occupations are foremost in importance. Workers in rolling-mills, blast-furnaces, oil-refineries and coal mines are particularly exposed. In the south, where sugar boiling is carried on extensively and in the turpentine camps many burns result. In large cities where steam laundries are common a peculiarly distressing form of burn occurs. The ironing machine consists of two rolls superimposed; the upper one cold the lower one hot. A common accident is for the "feeder's" fingers

to be drawn between the revolving rollers resulting in a crush and a burn of the hand; the burned area being always upon the flexor surfaces of the fingers and palm.

In the arts and trades where escharotic acids and alkalies are used many burns result which are notable for tenacious eschar formation. Electricity, finally, must be added as a common source of burned wounds. They are characterized by death and instantaneous formation due to the intensity of the heat. The wounds present a clean-cut edge, with no redness, and become covered with a brownish eschar; owing to the depth, healing is slow and the scars left are very plain. Hutchinson reports a case in which a very severe electric burn occurred in an individual of such rapid formation that the clothing was not scorched. In this connection so-called burns following X-ray examinations may be mentioned. Prof. Roentgen's dogma that the X-ray is non-calorific has not been disproven.[1] Any case of burn which has resulted from the use of this latest and greatest appliance of electricity to medical science has been due to the heavy electric currents employed in the generation of the X-ray and not to the X-ray itself.

Burns of the throat and nasopharynx are common and always of serious import. Scalding from hot vapors or fluids, when severe cause rapid edema of the mouth, nasopharynx and the

[1] Recently William Roelins sought to show that the X-ray does produce heat effects. A strong male guinea-pig, placed in a grounded Faraday chamber and exposed to the X-ray two hours daily, died upon the eleventh day of the experiment. A second guinea-pig died on the eighth day after a like exposure. In neither instance were external burns found. From the results of these two experiments Rollins considers that there is an ever-present danger in the use of the X-ray. He advises the physicians to wear glasses of the most non-radiable material that is transparent when using the flouroscope. For the better protection of the patient he would have the X-ray tube covered by non-radiable box from which no X-rays escape, excepting the cone of rays which covers the area to be examined or photographed. The patient should be covered by similar material excepting only the necessary area for examination.

larynx as low down as the vocal cords, followed by a gradually increasing dyspnea, until asphyxiation causes death. Cases which are stated to have died from inhalation of flame have really been asphyxiated by smoke, noxious gases of combustion or mechanically suffocated by direct action of the flame. The presence of carbonaceous matter in the mucus contained in the larynx and trachea proves the inhalation of smoke. In such cases the blood is found of a bright red color, as are all the viscera, with large quantities of bloody fluid sometimes found in the arachnoid spaces, death having been caused by carbon-dioxide poisoning. When in addition the blood is found fluid, high heat has been present. The quickness with which death comes after burns of these parts is well shown by the history of a case reported by Dr. Cleaves of a strong young man who inhaled powdered lime. The symptoms began with coughing and violent pain coming on almost immediately and requiring opiates to subdue. The throat and mouth became edematous, congestion of both lungs took place, moist râles being heard all over the chest. Diarrhea and delirium, with a temperature of 104.5° F., came on with death at the end of 48 hours. Dr. Cleaves thought that the lung congestion was due to a progressive inflammation beginning in the throat, lime particles not entering the bronchi.

E. Schmidt in his report of a case shows the rapidity of action of a scald of these parts in a child, aged three years, who tried to drink from a long-spouted, boiling tea-kettle. The child died next day from paralysis of the heart, following a left-sided pneumonia. Upon postmortem examination the mouth and pharynx were found normal, due to the length of the spout, compelling the child to throw his head back for suction. The

entrance of the steam or boiling fluid caused an attempt to scream which demanded a deep inspiration of air and the hot fluid. The epiglottis was thickened and the mucous membrane covering it necrotic. Upon the ridge of the larynx where it joined the esophagus a cresentic necrosed area was found.

According to Dr. Posey lime burns are the most common and the most severe of burns of the eye. The danger lies in the quick chemical change which takes place, accompanied by high heat.

Burns about the mouth, eyelids and the neck are important from the amount of deformity which occurs due to the contraction of the healing wounds. Where the eyelids especially are involved in the cicatricial tissue, eversion or drawing of the lids and displacement of the lacrimal canaliculi occur. This allows the tears to run down over the cheeks because of a continuous conjunctival inflammation due to dust particles which find an easy entrance to the sac. When the mouth is drawn, constant dribbling of saliva and impediment to speech follow as a consequence. Hot liquids, alkalies, and acids swallowed commonly result in esophageal constriction, with accompanying contractions of the stomach if disintegration of that organ does not at once occur as a result of the direct action of the heat agent.

Burns occurring over the large joints, serous cavities or the bladder, are especially capable of producing great internal reaction as the internal organs must take on the extra work of the destroyed skin. Serous inflammation is more common than mucous inflammation after burns and Heath points out that a burn over the front of the body is more serious than one over the back. The extent of area is also more important than the depth of the injury; Druitt observes that extensive

burns even of small severity are always dangerous. A burn over the belly is often followed by peritonitis or enteritis; Dr. Smith has reported the case of a woman burned upon the abdomen over an area of five by seven inches. Symptoms of peritonitis developed, and suppression of urine occurred. There was no movement of the bowels for a period of eight days. At the end of this time the wound became perfectly clean and at once all untoward symptoms passed away.

Burns over various parts of the body have at times caused abortion, also placenta previa as a result of the nervous shock; one case being reported of a woman burned over her belly, who was in the seventh month of pregnancy, at the time of the accident; on the fourth day acute peritonitis set in lasting four days; upon the eighth day, when the woman had nearly recovered from the inflammatory complication, labor set in and in seven hours she gave birth to a dead child. Upon examination bullæ were found upon the fetus.

Dr. S. P. Crawford reports a markedly similar case:

Inflammation of the lungs, pleuræ or bronchi following burns of the chest are common.

Brush burns and grazing missile wounds are often very like direct heat injuries; Mr. Horman says of the latter that they give an appearance to the skin as if it had been burnt by a hot iron rod. This is due to the removal of the superficial epiderm which exposes the true skin which turns brown after a few hours.

A peculiar complication resulting after a burn occurred in a patient of Dr. West's. A man, intoxicated, in falling, set fire to some fuses in his pocket and was burned over the lower part of the abdomen, the genitals and thighs as low down as the knees. The patient recovered, but with an extreme condition of phimosis.

A case of tetanus is reported by Dr. Godfrey as occurring in a man burned with phosphorus over the chest, hands and groin; symptoms began on the tenth day, with death in forty-two hours.

Fenwick speaks of a tendency to scarlet fever in children after burns. Two cases out of every eight observed by him developed the rash, throat, tongue and temperature symptoms of scarlet fever on or about the fourth day.

The commonly accepted designation of the severity of burns is that of Dupuytren, who made an anatomical classification of six degrees. Some surgeons, as Stephen Smith, Heath, Keen, Warren and White, make but three divisions, differing from him in that the burns of a severe type are grouped as one; while Gross divided them into complicated and uncomplicated, believing that it is owing to the many divisions into degrees of severity that so many forms of treatment exist (Holmes states that the treatment of burns is a subject upon which many books have been written and perhaps more numerous remedies recommended than in any other branch of surgery) and that by simplifying their description, surgeons would become more uniform in their treatment.

I would divide burns into two classes, (1) all those which affect the skin, from slight inflammatory reaction following a scorch to destruction of the true skin; (2) all others, thus making involvement of the true skin the dividing line. The two classes may occur on the same person due to the difference in temperature toward the edges of the agent producing them.

The reaction of tissues to burns varies from the faintest browning of the glow of redness from

a flame scorch, to black carbonization of the parts.

The variable effects constitutionally may be shown by a description of two contrasting cases which I saw in the Pennsylvania Hospital. A young woman was brought in burned over her whole body, excepting the palms of her hands which she had clenched. The burn was very superficial; her eyebrows, eyelashes and hair were but singed and over her body the burn extended no deeper than the epiderm. The woman in her night dress had upset a lighted lamp on the bed-clothes and though but a flash of flame thus momentarily enveloped her as she sprang from the bed, she died within four hours, shrieking her agony until subdued by morphine. The other case was that of a similarly caused accident to a man confined to bed with a rheumatic attack. He was deeply burned through the skin, subcutaneous tissue and fascia over his back from shoulders to buttocks. The whole sloughed looked not unlike a great sheet of lichened bark from an old tree. This man did well, was kept in bed but a few days, and then was able to walk to the clinic to be dressed, and went on to uninterrupted recovery.

The pathology of burns is the pathology of inflammation of the part locally affected, with almost all the morbid changes possible in the complications arising therefrom. A severe burn can open the way to the onset of many diseases, both medical and surgical, each fatal to life. From the grasp of the demoralizing fright of the moment of contact of the destroying element through the subsequent period of shock, followed by febrile action, internal congestion of brain, lungs or other organs, during the reactive period, burns may prove fatal at any time. Later, death may come from secondary hemorrhage, perforation of

a duodenal ulcer, exhausting diarrheas or suppuration, disintegrating blood changes with absorption, causing pyemia, septicemia and embolism; also secondary parenchymatous inflammation of the kidney, with uremic poisoning and amyloid degeneration of the liver, spleen, kidney, and gastro-intestinal tract. Incidentally from without, erysipelas or tetanus developing may cause a fatal issue. Where life is not endangered, the local effects of ulceration, cellulitis, abscess, sloughing and gangrene, causing deforming contractions with loss of function, overgrowth of scars, sometimes involving nerves in the meshes of the fibrous tissue and slow healing ulcers, all handicap, thus giving this form of injury an importance which surgeons are prone to disregard.

The first action of heat is to stimulate sensory and paralyze vaso-motor nerve filaments, causing pain and hyperemia. This reaction may be instantaneously lost in severe burns as a result of loss of conduction where nerve trunks are involved, so that deep burns are less painful than superficial. This is well shown in the case reported of a foundryman who stepped one foot in a puddling-pot of molten metal with the result of complete solution of the member; he, however, suffered no pain. In a slight burn this stimulation causes an outpouring of fluid from the papillary loops of the capillaries in the corium. This bulges up the epiderm and forms vesications or blisters. Moist heat is more stimulating than dry, Neumann having found that moist heat from 167° F. will cause vesication, while 212° F. and over will destroy the skin in part or entirely. Much higher temperatures than these may be withstood if the heat and the portion of the body to which it is applied be dry, as illustrated in treatment by the application of dry hot air in certain cases to 400° F. or even 420° F.

The fluid contents of blebs or vesications is not serum, but serum plus fibrin ferment which in a few days if left alone causes an albuminous coagulation. The formation of this fibrin ferment is the cause of a rise in the body temperature and Horrocks speaks of a systemic poisoning action (non-bacterial), which develops at the same time.

Fluid and semi-fluid particles may both be absorbed from a burned area although, following the formation of granulations, little absorption takes place. The fibrin-ferment fever in simple inflammation is similar to the first rise in temperature after reaction in burns, not due to early sepsis. Horrocks says that there is first a period of quiescence before this reaction takes place.

Directly after a burn during the period of shock the temperature falls to 97° F. or as low as 95° F.; then rises at reaction to 104° F. or as high as 106° F. That absorption does take place he proves by reference to the action of the thermal cautery. He says we may for illustration divide the area of a scarified wound into three divisions, (1) the part most affected by heat; no water is present and the tissues are carbonized; (2) area of active inflammation; the vessels are plugged with clots and contracted, the lymphatic vessels retracting less than the venous and arterial capillaries on account of having less elastic tissue in them, absorption can readily take place; (3) area of active hyperemia, great diapedesis due to increased blood-supply, making it feel hotter and look redder than natural. Thus, in a simple scarification, we have an example of what occurs after a burn.

The mass of the eschar after a burn may be thrown off in either one of two ways, namely, (1) by a demarking inflammation with but little attending discharge which can be absolutely asep-

tic. Complete charring forms tar-like products of distillation, which are naturally unadapted for infection of micro-organisms. The mass shrivels, mummifies and is cast off finally as a dry slough. (2) Infiltration of the slough due to activity of the micro-organisms which lying in the depths of the skin escape the heat's action; or due to those which wander in afterward.

The action on the skin causes it to become a yellowish, greasy pulp or to be thrown off in shreds and layers. A poison develops which belongs to the group neurin and muscarin, derived from cholin; their great virulency is shown by the action of muscarin, 5 milligrams injected causes symptoms of poisoning in a man. Putrefaction goes on, with water formation, the moisture extending into the tissues beneath, where these elaborated poisons are readily taken up and carried into the general system. A rich supply of oxygen favors their development; oxygen being necessary to produce virulent ptomains.

Deep burns are relatively less dangerous than those superficial burns which produce white eschars: Over a given area a scald or a flame scorch will cause less destruction than does fire, while molten metals burn deepest.

The early visceral changes after severe burns are well shown by Dr. Russel who reported the postmortem findings in the cases of five children who died a few hours after the accident. The liver and kidneys were swollen, spleen enlarged and softened with moderate hyperemia of all the organs. Most striking was the swollen appearance of the lymphatic glands and the gastro-intestinal lymph-follicles. Focal changes about their germinal centers had taken place wherever lymphocytes were found, from the small nodules in Glisson's capsule to the largest lymphatic glands. The germinal center was enlarged so

that it could be seen by the unaided eye. The protoplasm of the cells was broken up, while certain endothelial cells in the neighborhood, acting as phagocytes, had taken up the fragments of protoplasm and nuclei. In the blood, fragmentation of the red blood-corpuscles, especially in that taken from the spleen, somewhat less so in the liver, had taken place. In the skin thrombi appeared and in the Malphigian corpuscles the same changes had occurred. Russel explains these various changes by assuming that toxins elaborated by destruction of the superficial layers of the skin pass into the circulation, and when the arteries of the lymphatics break up into capillaries the rapid flow of plasma causes the edematous swelling and tends to sweep the lymphocytes into the pericuticular lymph-sinuses.

Nearly identical changes to these have been found in the lymphatics of children dead of infectious diseases. Frankel and Spiegler implying the same principle in their statement that the fatal effect of burns is due to intoxication from absorption of pathological cleavage products of the body proteids; death being therefore due to an acute toxemia.

That grosser lesions may result from these causes is well shown in a case reported by Dr. Granges of a boy of eight years who was burned by a redhot coal falling from the fire and rolling over his arms, belly, genitals and legs. Death occurred on the fourth day from a fibrinous clot found in the longitudinal sinus.

Fenwick holds that early death and internal complications after burns are due (1) to alteration in shape and diminution of vital properties of the red blood-corpuscles. Schultze found at a temperature of 54° C. (119° F.) that red blood-cells became shriveled and partly disintegrated, thus losing their power of carrying oxygen

when most needed; also an abnormal loss of body heat occurred, due to paralytic dilatation of the blood-vessels and the fact that blood being a good conductor of heat, destruction of the epidermis, a poor conductor, allowing the loss to take place. (2) This fragmentation causes thrombi and stasis in the lungs, kidneys, intestines, liver, brain and subcutaneous cellular tissue. Thrombi are most numerous in the terminal branches of the pulmonary artery and are found during life. This causes obstruction to the emptying of the right ventricle and therefore general arterial stasis with consequent arterial anemia.

These conditions cause hemorrhages. Sometimes cardiac thrombi occur alone, giving rise to precordial pain, irregularity of the pulse, with obstruction of the pulmonic circulation and dyspnea rapidly increasing until death, ulcerations, and parenchymatous changes in various organs. Thus may be explained dyspnea, cyanosis, coma, smallness of the pulse and the various lung affections, convulsions, anemia and fall of body temperature after severe burns. The fatal issue after small burns in children is due to (1) a more intense action of heat upon the corpuscles; (2) weaker resistance, owing to the thinner skins of the corpuscles; finally, the comparative weakness of the heart and circulatory apparatus generally. This is borne out in fact by the report of an examination of a child, two years old, scorched over the upper part of the body, who died comatose after twenty-four hours. At the postmortem there was found congestion of the lungs and the brain membranes; arachnoid fluid in the ventricles, with engorgement of the vena cava and the right heart.

Convulsions are often the symptomatic cause of death in children, owing to their greater nervous susceptibility. When the blood changes come on

quickly, excess of function is excited; but when some time has elapsed, structural changes take place.

Erichsen in examining 119 fatal cases of burns found complications affecting the brain in 33 out of 37 examined, complications of the viscera in the chest cavity in 30 out of 40 cases examined and of the abdominal organs in 31 out of 42 cases.

Dr. Jenner has described the postmortem findings in 17 cases of burns, the victims of a tenement fire in London; they were of all ages and of both sexes. Cadaveric rigidity had rapidly taken place and was due to cooking of the muscles with shrinkage after death. This caused extreme flexion, which took great strength to overcome, recurring when pressure was removed. Dr. Jenner thought that in some instances where extreme shortening had taken place, an antemortem convulsive contraction had occurred before fixation by heat coagulation. The claim agent of one of the eastern railroads detailing to me the account of an accident which occurred on his road several years ago in mid-winter, when twenty-two passengers were burned and scalded to death, stated that it was impossible to straighten their flexed and contorted bodies. The jaws were found to be firmly clenched, so tightly in some cases as to cause blood to exude from the tongue. Excepting in a few cases the blood was found fluid in the heart. The liver, spleen and kidneys, all much congested, with dark, venous blood. The bladder was found contracted. The mucus in the nose and throat was of a blackish color, due to smoke and inhaled carbon particles. The lung tissue was of a rosy tint. Burned areas which had occurred after the death of the victim had no red halo surrounding the charred area as did those which caused death.

One man was found with bits of plaster in his mouth and throat, with mucus black from carbon: this in connection with the presence of charred burns, without inflammatory halo being found proved conclusively that the man had been smothered by smoke and noxious gases and not burned to death. A medico-legal point of great importance; could be thus settled with ease. In this connection a practical point may not be amiss; firemen are often enabled to go long distances, through smoke and combustion gas filled rooms and halls, by creeping close to the floor, as the heavier uncharged air occupies a space of a foot sometimes as much as two feet above the floor. Bloody fluid was found in the pleural cavity and in the pericardium, though not over half an ounce was found in any one case.

The function of internal organs is to take on the extra work of the destroyed skin after burns; Freund and Russ have shown that the urine of those badly burned contains pyridin which Fraenkel has obtained by decomposing albumose with sulphuric acid; hence it seems possible for heat to cause a similar action in the bodies of patients. These authors have studied the urine in four cases of fatal burns and always found three abnormal constituents. The first is a series of bases of the pyridin type. The second is cysteine or is closely allied to it. The third from its reactions seems to belong to Pavey's group of carbo-hydrate derivatives of proteids. The urine was free from albumin and nucleo-albumin.

The author's theory requires for substitution the artificial preparation of these substances from proteids and the study of their effects upon animals; an important clinical fact seems to be that their presence in the urine is of grave import.

The degree of body temperature seems to be a factor in the production of kidney congestion.

This is shown by reports of clinical examination made daily and systematically over long periods of time, at the Pennsylvania Hospital. It was demonstrated that when the temperature in a given case was below 101.5° F. in burns of whatever extent or severity, no albumin was present in the urine. Where kidney congestion is a special complication, albuminuria and hematuria are due to the acute nephritis. Amyloid change in the kidney after long suppuration may alone be the cause of albuminuria. Glycosuria coming on acutely and lasting four weeks is reported in one case after a slight burn.

The course of a burn is of importance to the surgeon from its very inception. He has not only to deal with local wounding, but with a constitutional reaction on the part of the individual injured as well. Under the head of shock are these constitutional manifestations described; and to it must be ascribed the chief cause of early death after burns. According to Shrady shock is a jar to the equilibrium of the entire sympathetic system, of which mere pain is oftentimes an insignificant part. Mitchell, Morehouse and Keen add to this enfeeblement of the heart's action through the mediation of the medulla oblongata and the pneumogastric nerves.

In a group of ten cases of burns occurring at one time, reported by Ashhurst, six died of shock within the first twenty-four hours.

A. E. Durham and Bryant agree that shock kills one-half of all fatal cases of burns. While young people stand shock very well, as do females better than males, infants and nervous women are very susceptible to its influence. The causes of shock are dependent upon the nature and extent of the burned wound. Burns of the chest and belly cause greater shock, other things being equal, than do such injuries of other parts;

again, burns cause greater shock than do scalds. In Bartholomew Hospital, during a period of ten years, burns were found more fatal than scalds in the proportion of 26 per cent. to 9 per cent.

Pain, fright and loss of body heat are factors in the production of this condition. Heath believes that shock is kept up so long as there is any pain present, and Sonnenburg states that the sudden irritation of the sensory nerves, so numerous over a burned area, may be followed by paralysis of the heart, which, superadded to overheating of the blood, explains the sudden early death after cases of superficial burn. Lustgarten holds to the theory of intoxication, following burns of cutaneous surfaces when early fatal. Sonnenburg, however, contends that in as much as Lustgarten's cases all had an eschar, death was due to overheating of the blood, with consecutive thrombus formation. The temperature in such cases will rise a few tenths of a degree; there is an interval of cerebral and spinal irritation, followed by symptoms of paralysis and coma, all simulating alkaloid poisoning.

The symptoms of shock do not always appear at once; the period of depression following these injuries is given by most surgeons to be about 48 hours. Fell states that the time for the appearance of shock may vary from 1 to 48 hours, and during this time the patient may be moved without harm.

During the period of depression the temperature falls and the patient feels cold and shivers; pain is oftentimes continuous. Following this is the period of reaction, lasting at times ten to fourteen days, and characterized by an elevation of temperature and internal congestions. An insatiable thirst is often an accompaniment and when the stomach is unretentive, adds to the dangers of the condition.

Fenwick, speaking of this complication from his experience in London Hospital, says it is an axiom at that institution that if a burn case vomits soon after admission, it will die. Hebra, Sr., and Kaposi, with their great experience in these injuries, state that they never saw a recovery after vomiting had set in. It is during this period that duodenal ulceration occurs; a complication to be more fully dwelt upon later.

Following reaction, the patient passes into what surgeons generally are pleased to call the stage of exhaustion. During this time more or less suppuration is taking place, and there is danger of death from exhaustion alone. Extraneous causes, such as erysipelas or tetanus, may be superadded to the suppurative process or to visceral damage. Diarrhea very often appears as the immediate cause of death.

A complication to which Curling, before the middle of the last century, first directed attention is ulceration of the duodenum. He noted that it was common in children and that when it occurred it was dangerous, death being due to hemorrhage, or to perforation and peritonitis. The cause of this lesion according to Curling, was an attempt upon the part of the adenoid tissue in the duodenum to assume the function of the destroyed skin. Since his time, many cases have been reported by others and must study and endless discussion as to the cause of this lesion have resulted. That it is not so common as it is important when it does occur is shown by the following statistics from Guy's Hospital in which, of a series of 37 fatal burn cases, 12 dying between the third and sixth days, examined for this lesion, no intestinal inflammation was found.

Holmes in a report on 125 postmortem examinations after fatal burns found 16 patients with ulcerations of the duodenum. Of these 5 died

on the fourth day, 5 during the second week and 6 at a later period. At Bartholomew's Hospital 138 deaths from burns, with postmortems, took place in ten years; of these but three cases of inflammation of the gastro-intestinal tract occurred. In London Hospital, Dr. McCarthy saw but 2 cases of duodenal ulcer in 8. Erichsen reports 2 deaths from duodenal ulceration, after examination of 68 cases of fatal burns; and in another series of 22 cases in which postmortem examination of the abdominal organs were made he found them healthy in 5, generally inflamed with some trace of peritonitis in 11, duodenal ulceration in 6 cases.

The cause of this ulceration according to some surgeons is unknown, others believe it is due to poisoning of the adenoid tissue, especially that of the duodenum, which comes from the blood, or is thrown off by the liver in the bile. This explains why the ulcer is found most often in the pouch of the duodenum, placed posteriorly, just below the opening of the common bile-duct. This theory was supported by Wm. Hunter who used the following experiment to show that poisons generated by absorption of matters from the site of a burn are the cause of duodenal ulcers. He injected subcutaneously in a dog from 3 to 5 milligrams of toluylendiamin and later examined the viscera for pathological changes. In animals thus treated an intense duodenitis was found, due to the excretion of the poison by the bile. Hemoglobinuria occurred after the injection of the drug, as it does after certain burns.

Another theory and one which I think is well borne out in fact, is that of thrombus formation. It has been well proven that fragmentation of the red blood-cells occurs after burns and that semi-solid particles are absorbed and carried into the circulation. It is an incident whether the throm-

bus be carried to the duodenum or to some of the other viscera; after the capillary embolism has taken place, antemortem digestion completes the process of ulcer formation.

In my readings upon this subject I have found many descriptions of duodenal ulcers, but no clear narration of cases where this lesion occurred alone. Grange reports his findings of a suspected case of duodenal ulcer; a man burned variously over the body to one-sixth of its extent died on the fourth day. At the postmortem examination no duodenal ulcerations were found, but disintegration of the stomach had occurred.

Tay reports the case of a woman, aged forty-eight years, burned over the chest, neck and face, by a paraffin lamp. The most prominent constitutional symptom was pyrexia; death occurred on the twenty-fifth day. Upon postmortem examination of the arch the aorta was found full of coagula; the valves and heart were normal. Two ulcers were found on the curve of the stomach, but no lesion of the duodenum was found. It would seem in this case that the continued high temperature gave rise, as borne out by the experiments of Schultze, to an increased tendency to fragmentation and clotting of the blood.

Another case is reported of sudden death after a burn from hemorrhage of the stomach. Upon postmortem examination no gastric ulceration, but congestion of the mucosa of that organ was found. In the duodenum, neither an ulcer nor congestion were found.

Carhart records a case of suspected ulcer, with recovery, after a burn which extended over a total area of six square feet. After four days the stools became clay-colored and of a cadaveric odor, with the symptoms of a duodenal ulcer developing. The patient laid on his back most of

the time, and while healing was protracted, bedsores forming, the patient recovered.

Hill reports a typical case, following a scald of the legs, back and buttocks of an idiot girl, aged eighteen years; death occurred eighty-three hours after the accident, vomiting having come on after twenty-four hours. At the postmortem, a perforating ulceration the size of a shilling was found on the posterior surface of the bowel two inches from the pylorus. Its edges were pulpy, somewhat thickened and adherent by plastic lymph to the head of the pancreas. The surrounding peritoneum was inflamed. The stomach was found empty, slightly injected and inflamed. The lungs were somewhat congested. No hemorrhage occurred from the bowel.

A case of frostbite is reported to have finally ended in death from duodenal ulceration, as was proven by subsequent autopsy.

Symptoms of ulcer formation are usually meager. From descriptions of the suddenness of the onset of the condition, a study of the temperature is important. A sudden fall occurring especially between the fourth and twelfth day should excite grave suspicion; the time cannot be set down as unvariable, however, as a case is reported as occurring one hundred days after the accident. Ulceration, however, occurred in the large intestine. This subsequently healed.

Annandale reports a case of death from duodenal ulcer on the seventy-fifth day after the burn was received, the fourth day of the ulcer. Holmes recites the history of a patient of his whose death occurred from a duodenal ulcer, three years after recovery from the burn had taken place.

A typical duodenal ulcer, following a burn, takes the form of an indolent, circular, non-indurated, punched out ulceration and when deep, lymph is thrown out upon the peritoneal surface,

offering thereby a natural protection from perforation; or, after a perforation has occurred, plastic lymph may at times be thrown out in sufficient quantity to occlude the opening. When ulceration into one of the duodenal blood-vessels occurs, fatal hemorrhage is the rule, likewise, connection with the serous cavity of the peritoneum with a developing peritonitis will cause the death of the patient. From the fact that cicatricial ulcers have been found in patients who died of complications after burn injuries, the importance of a given case will rest on the amount of surgical injury produced.

Contraction after the healing of burned wounds is of common occurrence. The depth of the wound is not the chief factor of its production for many burns which extend only through the skin have been followed by the greatest contraction. Friction during healing is the principal factor. It is for this reason that burns over the flexures of the joints are especially liable to this complication. The greater the friction caused by muscular movement (applications or dressings, must be added as a source of granulation irritation) the more exuberent will be the granulations. The larger the granulations, the greater will be the amount of connective tissue and the more will be the contraction.

Treatment.—Deaver has stated that every medical book is a rehash of what has gone before, but this must ever be so where true advance is made. The foundation of medical science has been laid and what is to come needs no firmer base. A man writes surgery because he thinks he has learned how to do things and wants to tell others how well they can be done. I have no new theory to present in regard to the treatment of burns. Many and varied have been the methods of treatment suggested and advised for

these injuries; from the cook's dredger to complicated germicide mixtures, the underlying principle has been the same, namely, to prevent mechanical irritation of the surface of a hypersensitive wound and allow granulation to go on unhampered.

Hippocrates secured the least friction, consequently obtained the best results, in his treatment of burns by using lard and aromatic oils; to-day, carron oil is the common remedy for burn wounds. Oily applications to burns have the disadvantage of becoming rancid and dissolving otherwise aseptic sloughs which are dry from charring, and allowing infection to take place through the sloughing mass. Dressings become saturated and dry with a crust which causes irritation of the wound surface.

Gross found that carbonate of lead mixed with oil, common white-lead paint, applied to burns added to the value of mere lubrication by providing a support for the granulations; thus carrying out the idea of scab formation in wound healing. The coagulation of the contents of vesicles and the serum poured out upon the surface of a burn wound is plainly Nature's attempt to form a base for granulation formation, but pus infection too often mars the plans. Guzzo helped scab formation by using glycerin. Bilroth employed a solution of 2-per-cent. silver nitrate, painting over the whole wound. He stated that, though very severe pain is sometimes caused by this method, an eschar is formed and healing takes place more rapidly than by other methods of treatment. Skey uses a 10-per-cent. solution of the same drug, with a similar object in view.

The danger of using the silver nitrate eschar as a protective and support for granulation lies in the fact that infection will take place beneath

it and being confined increase the irritant action of the pus organisms.

Velpeau found that pressure by adhesive straps would promote healing, and by this means secured support for granulation formation. Druitt followed out the same principle when in burns which refused to heal he employed a sheet-lead plate cut to the size of the burn and held in place by adhesive plaster. He gave absolute rest o the part, prevented friction and the burns got well.

As a friction protective silver-foil has lately been employed in the treatment of burns at the Johns Hopkins Hospital.

Picric acid in various solutions has been advised as an early treatment for burns before granulation commences; it is said to deaden pain.

Heath forms a scabbing solution by mixing one part of collodion with two parts of olive oil; using it especially for burns about the face.

Pure carbolic acid in solution, lately advised by some surgeons to be painted over burns, counteracts its virtues by being often very painful and by causing additional eschar. Although the intention is to cause a sterile, superficial eschar to be formed over the surface of the wound, we cannot be positive that micro-organismal (pus) growth has not taken place beneath the slough. It is therefore not a wise procedure to so seal up a burn wound.

Copeland reports two cases which were treated in an orignal manner by him along the same lines. The first patient was a man whose face, ears and hands had been burned in a boiler explosion. He had been treated with cotton and cosmoline dressings daily with no benefit and was in great pain, with wounds freely discharging. By the use of mosquito-netting the face was protected, and from pasteboard the doctor constructed open-end boxes in which the hands were

placed and so held by means of plaster that they did not come in contact with the pasteboard; the ends were covered with netting to keep off the flies. No other dressing was used. By the next day all discharge had ceased, pain had disappeared, and there was glazing of the open wounds. Recovery commenced at once and was uninterrupted, leaving little disfigurement. The second case was that of a little girl, aged two years, whose clothes catching fire, was burned on one of her thighs over an area of two by three inches. Household remedies caused the wound to do badly; at the end of two weeks, fever developing, Dr. Copeland was called. He formed an oval pasteboard cover retained in place by adhesive straps, which he left over the wound for three days. Upon removal he found a well-formed scab, no fever, and healing well advanced.

By a study of the principles which underlie these different methods of treatment, we can arrive at but one conclusion. Secure protection for the granulations forming over a burned area and we will obtain a perfectly healed wound. There will be no danger of distortion of the scar or loss of function from contraction. Dusting powders of all kinds are as foreign bodies to burns and prove their irritant properties by the amount of discharge they cause.

Constitutional treatment of a patient burned is of the greatest importance and would naturally come first in a study of these injuries; but as I wish to direct attention to the treatment of a burn considered as a wound, I place it last.

The commonest and most dangerous source of irritation to a burned wound is infection. Suppuration has been considered by most surgeons as inevitable and, until Morton and Morris began advocating antiseptic treatment of these wounds when first seen, nothing was done to prevent this

condition. The latter surgeon writes strongly and says common wound principles are "shamefully neglected" by the profession in these cases. These gentlemen, however, do not advocate frequent changing of dressings of burns and I find this teaching general in the writings of the profession. Morton states the great principle in the treatment of burns to be to allow the dressings to remain on as long as possible. Morris believes that frequent dressings are not only uncalled for but injurious.

From time immemorial it has been taught that air is an irritant to a burn and the common practice of some surgeons is, when dressings become saturated with discharge, to apply more dressings, externally, without removal of those beneath. Air is not an irritant to a burn and a burn wound which has been buried under layers of pus-soaked gauze or cotton batting for days is the better for removal, without fear of what the presence of air may do or that pain will be caused.

The pain of a burn is due to the direct action of heat upon the terminal sensory nerve-endings; continuous subsequent painful manifestations are due to the irritation of sloughing tissues, applications of dressings. The question of pain occurring when burns are dressed depends on the care in which the dressings are removed, and what the nature of the dressing applied next to the wound surface has been. Gauze, patent lint or cotton, dry and stick fast to this form of wound, as to any other where there is any oozing, and will irritate the granulating surface so long as it is on, causing pain when removed at the first dressing or at any subsequent one. The only danger which could arise from removing dressings and uncovering large burned areas is that from loss of body heat following destruction of the epidermis before constitutional reaction has taken place. As a lap-

arotomy wound becoming foul-smelling from discharges is not treated by piling on more dressings, no more should a burn. Seeking to defend his position, one surgeon, speaking of the discharge and odor which follow his treatment of burns with carron oil to which he adds iodoform, states that when a surgeon gets disgusted with the odor so that he is unable to endure it for the sake of his patient, who if seriously burned will not complain of the odor, he had better take up the occupation of horticulture as being more properly within his (nasal) sphere. This gentleman advises few changes of dressings to be made. Handled thus, burns will verily continue to be, as they are usually described, "filthy" affections to treat. It is painful to remove a drainage-tube from a through-and-through drainage of an abscess, yet a clogged tube is useless and becomes the determining factor of the temperature-curve tracings of that case. Aseptic surgery is the ideal toward which we strive; the surgeon who fails to keep clean (free from infection) until healed the wounds of the body which he makes knows he has fallen short and will strive in his future work to correct the faulty technic which allowed such invasion. Burns and scalds are wounds, as much so as an incision or a laceration, and demand as careful treatment. The earlier a burn can be dressed the better will be the result.

Of the household remedies it is sufficient to say that they should not be used. Friends would do best by the patient and assist the surgeon if they would confine their efforts to carefully cutting away whatever clothing was loose about the burn, wrapping about the wound a piece of oiled or wax paper, such as florists use, tied on with strips of muslin. A burn wound so handled is in the best condition for right treatment by the surgeon.

Removing the oiled paper protective; with scis-

sors and forceps cut away all shreds of burned clothing remaining about the wound. Puncture blisters and drain fluid which either will be rapidly absorbed with a febrile reaction or coagulating, awaits but the entrance of pus organisms to become a culture medium. Infection being ever present in the skin, by trimming away all detached fragments a source of danger is avoided. With care cut away as much of the burned subcutaneous tissues as possible; a curette may be necessary and when gently used will cause but little pain. An anesthetic is advised by some surgeons to be used when large, deep burns are to be dressed, and if it does not increase shock it may be useful at times. All of the burned tissues will not be removed at one dressing; inflammation must assist in the removal. Disorganized, dead, burned tissues must be cast off from the living, but we now know that the aid of pyogenic organisms are not needed to further this process.

In selecting an application for a burn, two principles are involved; the agent must cause no irritation and must be antiseptic. The most commonly used antiseptic drug in wound treatment is bichloride of mercury, but in hydrogen di-oxide we have that which to my mind is almost the ideal wound cleanser. According to Houssell of Tübingen a 3 per cent. hydrogen di-oxide solution is equal in power to a 1 to 1,000 bichloride solution, acting on bacteria suspended in aqueous solutions; but hydrogen di-oxide is superior to it in media rich in albuminous fluid, but poor in cells. Where the latter predominate it is again on a par with the solution of sublimate.

Bichloride solution of 1 to 2,000 strength applied to burned areas is often too painful to be borne and in children has caused convulsions. Carbolic solutions, boric acid, sodium bicarbonate or the like, in the strengths advised to

be used on burns are too weak to be of value and but add to the moisture of the part; if used stronger they become irritants and increase discharge.

Having cleared up the wound, it is next to be thoroughly washed by syringing with a solution of hydrogen dioxide, one part to six of distilled water. I have many times used a full-strength solution without causing pain, but routine treatment had better be commenced with weaker solutions. Much dead tissue will be dislodged and washed away in addition to that removed with instruments. When foaming has practically ceased commence the dressing of the wound by applying all over its surface and well over the edges to sound skin strips of rubber tissue in size about ½ to ¾ of an inch wide by three or four inches long; each strip to overlap the previous one laid down by a small margin. Rubber tissue is now made membranous in quality and it is this form which will lie best and cause least irritation.

A few layers of loose, sterile gauze is to be fluffed over the tissue and the whole held in place with a gauze bandage or by means of two or three narrow adhesive strips. To secure perfect rest we must place the part in the best position to obtain muscular relaxation, applying splints for retention and support. They should be well padded and held to the part by adhesive plaster, over which should be applied a muslin bandage to complete the dressing.

Dressings must be so disposed that no pressure upon the forming granulations will result or irritation will be caused. Barber uses rubber tissue in large sheets, wrapping it around the limb, as he says "the tighter and more snug the better will the air be excluded and

the quicker will be the recovery"; over this he applies absorbent cotton held on with a roller bandage. Where destruction of muscles, tendons or their sheaths has taken place after burn injuries, the mechanical balance of the mechanism of the joint affected will be destroyed with a commensurate loss of function dependent on the extent of the injury. In such cases the best we can hope for is ankylosis in a good position for future usefulness.

Dr. J. Webb, speaking of the hopelessness of the local treatment of old burns about joint flexures, which are ever contracting and breaking down, advocates radical surgery. One of his cases was that of a man suffering for twenty-one years with a burn of the popliteal space which refused to heal and destroyed the function of the joint. The second case occurred in a woman and consisted of a burn over the elbow, extending but through the skin. This wound healed and broke down continually, as did the other. Amputation was performed in each case. The patients did well and were decidedly less crippled after the operations than before.

There are cases which will require amputation after burns, but they will become fewer when the fresh wounds are given the careful attention which they deserve. The case of my own, which was the cause of arousing my interest in the treatment of these injuries, was that of a man burned on the outer side of the arm, over the bend of the elbow and the front and inner side of the fore-arm half way down to the wrist. The burn extended into the cellular tissue beneath the skin. Treating this wound as I have described, the scar tissue which formed during healing partook so closely of the nature of the normal tissues

that a perfectly restored arm was the result. A subsequent case was that of a man suffering from a scald of hot water over the front of his left leg, ankle and instep; carron oil had been used for three days before I commenced treatment of the case. With hydrogen dioxide, in full strength I syringed the wound, thoroughly washing away the masses of organized exudate and shreds of dead tissue, and trimmed away all of the blebs and loosened skin covering the scald. Rubber tissue strips were applied with gauze and bandage, as described. Pain, which had been a prominent symptom, and the discharge stopped at once, and though I had great difficulty in preventing movement of the ankle joint, as the patient returned to work after the first dressing, healing commenced immediately and went on to rapid recovery with a resulting scar which was freely movable and non-contracting. The granulations in both these cases were minute and closely packed from the commencement of the treatment until they leveled off and became permanent tissue.

The number of times that a burn should be dressed will depend on the amount of discharge which comes from it after the wound has been cleansed. Where there is danger of parts burned touching each other, they must be dressed separately to prevent distorted growth, particularly in the case of burns about the fingers and toes. To secure good results in burns of the hands of young children great care will be necessary. Burns of the palmar surfaces will require careful splinting until perfectly healed to obtain the best results. In such cases a posterior splint with a pad placed and held with adhesive straps so as to produce extension, is best. Cases which have

done badly had better be left until the child is five or six years of age before attempting plastic work. In burns about the lax tissues of the neck and over the flexor surfaces of large joints, immobilization by whatever means it can be best obtained is of special importance. A burn about the neck which destroys the skin requires absolute rest and, as in fracture of the clavicle, the result will depend on it.

As surely as we can mark the growth of large, angry granulations, so can we tell what the result will be in after-time when the patient returns with a terrible contraction. The application of caustics or powdered pepsin is but an attempt to balance friction and contraction and too often fails. Plastic surgery will step in and change the current of events, but ours is an era of preventive medicine; attention, therefore, during the early formative (healing) stage to the wound, along the lines of common surgical wound treatment, will be effective and such cases will become known from their rarity.

Burns of the face are described as generally doing well and cases are reported as healing without a cicatrix, even when deep ulcers were present, while similar injuries upon the extremities do not do so well, taking longer to heal without securing as good results. The idea of an extra blood-supply in and about the face causing wounds of these parts to heal quicker than those of other parts of the body is fallacious. Practically all tissues have capillaries and it is these vessels which are the important factors where healing is taking place.

I have found a wound of the back or the leg equally deep as one of the face or scalp to heal as quickly as the latter when I have secured rest and freedom from irritation. Again,

I find in my work that when I am not clean in a wound treatment, those of the face or scalp suppurate as quickly as do other parts.

Every individual has powers of healing equally developed over his body. Rest of the part, in its broadest sense, is the factor in the production of quick healing of a wound. An individual in repose or in activity will not move the facial muscles as much as his hands or legs if suffering from a wound of the face, hence the diversity.

Burns of the mouth and throat will require active treatment, which should be begun as soon as possible. Carbolic-acid burns of these parts, treated at once with alcohol, pure or dilute, as the requirements of the case call for, will promptly save life or prevent future constrictions. In cases of carbolic-acid burns from swallowed acid, we must remember that the antidote alcohol is a poison in itself requiring immediate lavage. Death occurred where this was neglected in the case of a child who having swallowed carbolic acid was given three and a half ounces of alcohol.

Edema of the parts should be treated by hot baths and diaphoretics; if no relief is obtained, scarify the base of the tongue, and pharynx, puncture the epiglottis and the sides of the larynx with a curved bistoury, guarded by a finger and wrappings of adhesive plaster or cotton; afterward use hot gargles and apply poultices to the sides of the neck. As a last resort, based on the fact that edema does not extend below the vocal cords, Ashhurst recommended the operation of tracheotomy, himself having performed it for edema of these parts after mouth and throat burns of various kinds twenty-eight times with five recoveries.

Lime splashes in the eye should be treated by dropping water acidulated with vinegar into the conjunctival sac. Copious irrigation by means of a strong force of water is often the best remedy. Particles should be removed with the moistened end of a handkerchief or a wisp of cotton twisted on the end of a match stick.

The treatment of burns due to the action of electricity in the production of the X-ray calls for absolute rest of the part and drugs to overcome pain, as shown by the case reported by Orleman. The burn took the form of an ulcer which refused to heal for ten months in spite of many forms of treatment, and was finally determined to be a trophic neuritis. A case has been noted in an English medical journal, which came to coroner's inquest alleging death from Roentgen-ray photography. A woman suffering from fracture of the thigh-bone in March, 1900, was exposed upon the sixth of April to X-ray examination for two hours and twenty days later to a like exposure lasting two hours and ten minutes. "The latter exposure was followed by inflammation, and, so far as can be gathered from the newspaper reports, by ulceration of the abdominal walls." The woman became mentally unbalanced and death followed.

The sun's rays may cause burns of the first degree of severity. If attended to at once before vesication has taken place I know of no better remedy than that of Dr. Wood, as follows:

℞ Vinegar or dilute acetic acid, fl. oz. j.
Glycerin .....fl. oz. j.
Bismuth subnitrate, q. s. ad to paste.

Sig. Apply to burned parts.

Where vesication has taken place the treatment is the same as for other burns.

F. Mulig reports two cases of systemic poisoning following the use of bismuth subnitrate as an

application for burns. In one case the treatment had been carried on for nineteen days, in the other for twelve days, when the patients began to suffer from stomatitis, salivation, blue line on the gums, and dysphagia. In both cases a thorough curettement of the wounds was necessary and a months passed before the symptoms entirely ceased. I think we need have no fears, however, of poison symptoms arising from the use of bismuth in this prescription for sunburn.

Skin-grafting is an important adjunct to the treatment of burns when large areas of skin have been denuded. Bryant lays great stress upon this procedure. McBurney, in skin-grafting for this and other forms of injury at Roosevelt Hospital, after clearing away and rendering the wound aseptic, employs rubber tissue as a protective in the form of shingles, in order that the salt solution, with which the gauze is wet may penetrate to the grafts. The rubber tissues, after being washed, is used again at subsequent dressings. Common oiled muslin was tried and found to be dry, stiff, hard and irritating; cotton batting was condemned on account of sticking and being irritating to the parts.

The constitutional treatment of a patient burned should be begun by placing him in a well-warmed room, in a bed screened to prevent drafts. Pain is the first symptom to be combated by the use of opium. To an adult, ¼-grain doses of morphine sulphate should be given at intervals of thirty minutes, until the pain is controlled. We must remember that it is the pain which we are treating and while pain is present we will not reach the therapeutic limit of our drug. Often ½ of a grain will be needed as a first dose. I have neither seen nor heard of harmful results from an

overdosage of this drug while pain was present. Should such a case arise we have but to employ the antidote for opium, which is cocaine in sufficient dose to overcome its action. To an infant give 2 to 4 drops of tincturæ opii or tincturæ opii camphorata, repeated at intervals of thirty minutes until quieted. Naismith advises the use of ice cold baths to the burned parts as a "preliminary" treatment until pain has passed away.

In Vienna a treatment is followed out which consists of immersion of the burned parts in water kept at the normal body temperature. Shock coming on the patient complains of cold. Blankets, hot bricks, bottles or bags are the external requisites to promote reaction. At once may be given hot drinks; such as brandy in one-ounce doses, strychnine gr. $^1/_{30}$, atropine gr. $^1/_{50}$. Baxter advises for shock, baths at a temperature of 95° F. continued for periods of two hours. Von Nussbaum advises baths at 100° F.; he says this treatment has decreased the mortality of burns in the hospitals of Germany.

Vomiting coming on during the course of a burn is at all times serious and, while it may occur at any time, it is particularly liable to appear with the reaction of the body from shock. The patient becomes very thirsty and great care must be used in the quantity of liquids given; thirst should be quenched with cracked ice. No liquids or medicines are to be given by the mouth. The strength of the patient must be kept up by rectal feeding.

Brieger reports a case successfully treated by atropine sulphate given hypodermically. His first patient suffered from an extensive burn of the first degree caused by clothing catching fire; he was placed on a Hebra water-

bed during treatment; on the second day vomiting began. Five milligrams of atropine sulphate were given during the course of the next two days. Vomiting ceased after the first injection; all threatening symptoms passed away and the patient recovered. In two other cases this treatment kept vomiting in check for hours, but did not prevent fatal termination.

Atropine is an antidote for muscarin. Brieger's theory is that by learning the nature of the ptomains given off in burns poisonous atom groups may be introduced which will unite to form non-poisonous compounds.

The bowels and bladder will oftentimes require continuous attention. The surgeon must bear in mind the danger of setting up a diarrhea after burns by treating constipation with aperients; enemas should be the only means used. The internal treatment of ulcers, should they develop, includes treatment for relief of the kidneys, diuretics, stimulants, with a milk diet. If uremic symptoms arise, produce diaphoresis.

During the period of reaction when everything must be done to support the patient's strength at this time internal congestions must be watched for and treated actively. Now, too, is the danger from pyemia from the patient being allowed to lie in a bath of pus of his own making and absorption taking place; frequent dressings of the burned parts is the preventive treatment.

Hopeless cases of burns may be put in the continuous Hebra water bath, or the burned parts wrapped, as suggested by Dawson, in sheets of rubber tissue, oiled paper or oiled rubber tissue.

Summary.

Burns are the commonest of injuries and of all wounds they are treated least in accordance with now universally taught and accepted surgical principles.

Burns may be divided into two degrees of severity; burns of the first degree involve the skin only, those of the second degree include all others.

The pathology of burns is the pathology of inflammation of the part locally affected with almost all the morbid changes possible in the complications which result.

Early death and internal complications after burns are due to direct action of heat, with fragmentation and vital change in the blood-corpuscles; later effects are due to infection taking place from the burned area.

The condition of the granulations during the healing of burns is the determining factor in the amount of contraction and subsequent deformity which takes place. The greater the friction caused by irritation from whatever source, the larger will be the granulations, the greater the amount of connective tissue and the greater will be the contraction.

The local treatment of burns from the earliest times has been along the lines of prevention of irritation, but the late advances made in wound treatment have not been followed out in these.

The burn wound should be cleansed of as much dead, burned tissues as possible; the thoroughness with which this clearing away of the eschar is done will determine in a great measure the amount of future discharge, and the presence or absence of infecting organisms.

Hydrogen di-oxide to wash away the débris and render aseptic the denuded parts is the best antiseptic at our command; rubber tissue in strips should be laid on the wound to prevent contact with the absorbent dressing.

The use of splints to secure relaxation and retention in obtaining rest for a burned part is of great importance and is as much indicated in this form of injury as in fractures of the contiguous bones.

The internal treatment of burns is stimulative until reaction from shock has taken place when it becomes supportive.

Opium fulfils the indications for pain, internal inflammations and diarrhea.

The bowels and kidneys must be continuously kept open, but enemas only should be employed.

Watchful attention must be paid for early signs of internal complications of the viscera.

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