Grave symptoms sometimes arise when a large surface (two-thirds) is implicated, and a case has been reported in which death occurred from violent dermatitis, with gangrene, following sunburn.

Burns are usually classified as of the first, second, or third grade. Dupuytren's division into six degrees is too complicated, and, though it was for a long time in vogue, it has been generally discarded by modern writers. The following classification is that of Thomas George Morton, and is the one generally accepted:

Burns of the First Degree.—Characterized by erythema, irritation, and inflammation of the skin without vesicles.

Burns of the Second Degree.—Vesication, inflammation of the skin, and formation of vesicles and bullæ.

Burns of the Third Degree.—Eschars; gangrene, superficial or deep, involving the skin or the subcutaneous tissues; carbonization of a part or of the entire body.

Prognosis.—The prognosis depends upon the depth of the injury and its extent, upon the susceptibility of the skin to the action of heat, and upon the general characteristics and physical condition of the patient. Burns of the first and second degrees generally result favorably, the patient recovering rapidly; in those of the highest degree, however, when the surface involved is very extensive, the prognosis is more grave; and even burns of the first degree may prove fatal when a great extent of surface is involved. It is generally accepted that, if one-half or even one-third of the surface has been burned or scalded, death, from some physiological cause as yet not clearly explained, will be inevitable; and this usually happens during the first twenty-four or forty-eight hours. I think, however, that much depends upon the patient's previous physical condition and mental equilibrium. In two cases which came under observation during my service in Bellevue Hospital, the burns involved more than half of the entire surface of the body, in varying degree at different points; but these patients both recovered. One of them was a strong and healthy engineer, the other a robust Italian laborer. On the other hand, even slight burns, in aged and enfeebled subjects, are sometimes a cause of death through shock. In all these cases, therefore, a guarded prognosis should be given. In burns of the third degree, which result from the application of intense heat, the prognosis will depend not merely upon the depth of the burn, but also upon the part of the body involved, and upon the age, sex, and temperament of the patient.

Symptoms.—*In burns of the first degree* there is more or less redness of the skin, which disappears on pressure, and which is accompanied by swelling and pain. This continues for a longer or shorter period, and then the epidermis is exfoliated and the natural conditions are restored. Recovery generally ensues in a few days and no permanent injury results. The constitutional symptoms are usually slight. Sometimes there is, however, an irritative fever, and if a great extent of surface has been injured, and if the patient is very susceptible, shock may be quite marked and even death may result.

In burns of the second degree the pain, redness, and swelling are more marked than in the first degree, and, the hyperæmia being greater, there is a tendency to exudation, and vesicles are formed. These, when large in size, are called bullæ. They either come on at once or form in a few hours. The serum is usually transparent, though sometimes it may be discolored by blood. Usually, along with the formation of the vesicles, the skin proper receives no damage, but sometimes suppuration and ulceration may take place. The constitutional symptoms vary according to the extent and severity of the injury. Shock is almost always present, and death results in some cases simply from this cause. Sometimes there is found a congestion of all the viscera, and death may result from cerebral effusion with delirium. With the rise in temperature, albumin is commonly found in the urine, and during the period of reaction ulceration of some portion of the mucous membrane of the bowel frequently occurs.

Burns of the Third Degree.—In this group are classed all cases of gangrene resulting from burns affecting the skin or subcutaneous tissue. Now, according to the intensity and duration of the heat, the skin alone, or the muscles, nerves, blood-vessels, and bones also, may be destroyed even to carbonization. This latter is, fortunately, a rare occurrence, but it sometimes happens that portions of limbs are entirely burned off while the individual is in a drunken stupor or is suffering from epileptic coma. The constitutional symptoms are, as may be supposed, severe. If reaction occur at all, the symptoms become at once quite grave, in proportion to the extent of the injury. In some cases death soon takes place from coma, due to cerebral congestion. The lungs, kidneys, and other organs are intensely congested, and this period of inflammation, so called, extends from the period of reaction to the beginning of exhaustion, during which time the dead tissues are being thrown off by suppuration. This exhaustion is sometimes increased by hemorrhages from the necrotic tissues. In all cases of burns of the third degree renal congestion is constant and gives rise to albuminuria.

The complications of burns may involve either the brain, or the respiratory tract, or the intestines. Cerebral irritation often appears quite early, and inflammation may follow and be accompanied by violent delirium. Convulsions and coma may occur in a fatal case.

Laryngitis, bronchitis, or pneumonia may occur from burns or scalds, the first frequently following the inhalation of hot steam. Œdema may be excessive, requiring tracheotomy in order to avert impending death from dyspnœa. Bronchitis and pneumonia are frequently observed to follow burns of the chest and neck.

Intestinal ulceration is one of the peculiar results of severe burns, and follows the intense congestion of the digestive tract that sometimes takes place. The intestinal lesions are present in varying degrees, from the simplest gastric irritation and diarrhœa to severe inflammation of the stomach and intestines, going on to duodenal ulcer, perforation, and death.

Treatment.—This varies in accordance with the severity of the injury. The indications are: First, to relieve the pain and overcome the shock; secondly, to guard against congestion and inflammation of the internal organs; and thirdly, to counteract the exhaustion incident to sloughing and suppuration.

Local Treatment.—In burns of the first degree there are usually no marked constitutional symptoms, but the local ones may be quite severe. These may be relieved by local applications of olive oil, vaseline, oxide of zinc, or other ointments of a soothing nature. Powdered bicarbonate of sodium is a most excellent application, and in simple burns it often affords great relief when freely dusted over the affected surface. Other alkaline applications may be used, among which a mixture of linseed oil and lime water, called "carron oil," may be mentioned as having long been popular. Flour, starch, white lead, paint, or any substance that excludes the air and makes a coating for the nerve filaments that have been irritated or uncovered will relieve the pain. Molasses has been used when nothing better could be found at hand in a case of emergency. The addition of carbolic acid to any of the ointments, or vaseline, or oil, is of much advantage, as it relieves pain and thoroughly disinfects any discharge that may occur. It produces a certain amount of surface anæsthesia, and, as carbolic acid is absorbed but feebly from any mixture with an oil, the danger of poisoning is not great. The urine should, however, be watched for any trace of the acid, as cases of such poisoning have occurred. An ointment made of boric acid and vaseline—*e.g.*, in equal parts—is of great service, as it allays pain and is perfectly safe. These remedies may be spread upon lint or old muslin and laid upon the burned surface, the parts being then enveloped in layers of cotton batting and all held in place by a roller bandage.

In burns of the second degree, in which we have vesication and inflammation of the skin, with the formation

of bullæ, it is absolutely necessary that the injury should be regarded as a wound and treated accordingly; *i.e.*, the burn should be rendered aseptic and kept so, if possible. It is well to bear in mind that only one part of a burned patient should be exposed at a time, in order to avoid surface chilling. Vesicles and bullæ should not be broken, but should be punctured at their lowest point and their contents allowed to drain off, and care should be taken that the cuticle should not be rubbed off, as it affords an excellent protection for the excoriated surface. The burned surface should be thoroughly cleaned; any cinders or any portions of clothing or charred material should be carefully removed, and the part should be rendered as aseptic as possible by washing and by the application of solutions such as mercuric chloride (1 to 10,000 or 20,000), aluminum acetate, etc. After these have been washed off with warm, decinormal salt solution, the burned surface may be covered with sterilized rubber tissue, which in turn is to be covered by a thick layer of sterilized gauze that is held in place by a roller bandage. When the inflammation of the skin is intense, a wet dressing of aluminum acetate or of ichthyol solution (three to five per cent.) should be applied and kept continually moist. Such an application will tend to relieve the pain and to render the burned surface aseptic. The rubber-tissue dressing, with its thick covering of sterilized material, acts as a substitute for the destroyed integument; it excludes the air and makes an excellent and painless covering. If now the wound has really escaped being infected, it will rapidly become covered by a renewed epithelial surface.

The dressings need not be changed oftener than every second or third day, unless the amount of discharge is very great or the odor quite marked.

It is quite proper to mention here the method of treatment of burns of the body, as well as of one extremity, by immersion. The clothing of the patient being removed or cut away, the limb or limbs or the entire body may be placed in a bath of decinormal salt solution, which should be maintained at a temperature of about 100° F. and not allowed to drop below 98.5° F. In cases of extensive burns, in which both legs and portions of the body have been involved, the placing of the patient in a bath of this character produces great relief, particularly as regards the pain and the amount of shock. The solution, which should completely cover the burned part, gives immediate ease, as it excludes the air; and, furthermore, if the temperature of the bath be raised sufficiently, there will be provided a most efficient remedy for the condition of shock. This form of bath not only cleans the injured portion of the body thoroughly, but at the same time renders it aseptic and maintains it in this state for a certain length of time. From time to time, as the solution becomes fouled, it will be necessary to renew it. The patient should not be removed from the bath until all sloughs have been separated and the denuded surface is ready for grafting. Propped on rubber air pillows, the patient may sleep or rest in the bath without danger. Provision must be made, however, for maintaining the temperature of the bath, and for keeping up its proper saline proportions.

In burns of the third degree, I would mention the fact that sometimes it will be found advisable to resort to an early amputation. The adoption of this course is indicated when the area burned is so extensive that the subsequent suppuration might prove too great a drain upon the patient's strength, or when this area occupies such a position that even if perfect healing should take place the remaining cicatrix would be constantly exposed to ulceration through the effects of abrasion or would seriously interfere with the use of the limb.

When the sloughs have separated, the ulcerated surfaces beneath are soon covered by florid granulations, which may require astringent applications or strapping with adhesive plaster. The treatment now becomes that of a simple ulcer, and may be guided by the same rules. Much good may be accomplished and deformity be avoided by keeping the various parts carefully separated, and by maintaining them in an appropriate position either by fixation on splints or by some proper mechanical appliance.

In the ulcerative stage skin-grafting is at times of great service, and large and indolent ulcers may be made to heal quite readily by this means (see article on *Skin-grafting*). Even transplantation of skin, as recommended by Wolf, may be employed with advantage in certain cases. If the patient, for example, has a large denuded surface, grafting becomes imperative; and the method of Thiersch is the best one to employ under these circumstances, provided the patient can be confined to bed in proper quarters. If, however, this is impossible, the epidermization of the denuded surface may be materially hastened by employing the method of engrafting portions of corns or callous portions of the skin upon the exposed granulating surface. As the details of this procedure are given in a later volume it will not be necessary for me to mention them in this place.

Treatment of Burns from Corrosive Acids, Caustic Alkalies, etc.—The corrosive or mineral acids which most often cause burns are sulphuric, nitric, and muriatic. In burns from these acids the application of water is to be avoided, as it causes, when mixed with the acid, a great and sudden rise of temperature. The proper treatment is to apply whiting or levigated chalk, which causes brisk effervescence, and at once neutralizes the acid; after this the part may be washed off with water. If this is done promptly, no more serious injury will result than a faint erythematous redness, accompanied by a slight sensation of smarting. Should by chance any of these substances be splashed into the eye, the organ should be well bathed in lime water, and subsequent inflammation should be treated in the usual manner.

The caustic alkalies are soda, potassa, ammonia, and quicklime. These act by suddenly abstracting moisture from the tissues. A fresh burn of this nature should be treated with vinegar, or with any other mild acid, which neutralizes the alkali, and forms with it an unirritating salt. A burn of the eye should be treated in the same way, care being taken to dilute the acid to a proper degree.

The treatment of shock from burns or scalds should be the same as when this condition arises under other circumstances. (See article on *Shock*.)

When reaction has commenced, a generally supporting plan of treatment is in order. Thirst, which is usually intense, should be allayed by small lumps of ice placed in the mouth, or by occasional sips of carbonated water. Constipation is quite common during the first two or three days following a burn, and a laxative enema affords the best means of relief. The gastric and intestinal disturbance often calls for treatment. The diarrhœa during exhaustion due to the profuse suppuration is best treated by opium combined with astringents, and by pepsin and bismuth. The diet should be simple but nourishing, and absolute rest is to be enforced.

John McG. Woodbury.

BURNS AND SCALDS, THE MEDICO-LEGAL RELATION OF.—The application of a moderate degree of heat to the surface of the body acts as a stimulant to the activity of the cutaneous transpiratory system, through its effect upon the capillary circulation. If the heat be raised beyond this degree, and to one incompatible with the integrity of the tissues, there results what has been denominated a burn or scald. Such difference of designation is based upon no special difference of character, but upon the nature of the causative agent.

For all practical purposes it is not essential to make a distinction between burns and scalds, yet it is sometimes important to decide upon the cause of the lesion observed.

Definition.—A *burn* is an injury resulting from the application to the body of a highly heated substance, flame or radiant heat. A *scald* is an injury produced by the application of a liquid, at or near the boiling-point.

Classification.—Burns are most simply classified ac-

cording to the severity of their injurious effects. They may accordingly be considered as:

I. Burns involving the skin and subcutaneous cellular tissue only.

II. Those which extend their injurious effects to the muscles, nerves, and blood-vessels.

III. Burns involving in their effects the internal organs and bones.

IV. Those in which the preceding classes are variously combined.

Class I. In this are included those burns in which a short contact with a heated body, or with water at or near the boiling-point, causes redness or scorching of the skin and considerable pain, leaving no permanent mark.

Class II. In the least severe cases the cuticle is destroyed in its entire thickness, and the injured parts are covered with yellowish-gray or brownish eschars. The skin surrounding the burned surface is reddened and, immediately or after a few hours, blisters are formed. Such cases heal without deformity and leave a shining cicatrix. In the severer cases the subcutaneous cellular tissue, the muscles, and the nerves are destroyed. Blackish eschars form which are without sensation and, ultimately, are thrown off by the process of suppuration, leaving a granulating surface. The surrounding tissues are reddened and usually a greater or less amount of vesication exists. In the healing process, the resulting cicatrices of the skin adjacent are prone to contract and produce deformity which in some cases, especially when affecting the head or extremities, demands extensive surgical interference.

Class III. So severe are the effects of burns of this class that the result is rapidly fatal. They are usually caused by an exposure to flame or to intense heat, more or less prolonged, and not only involve the lesions already noted, but also a charring or carbonizing of the parts exposed.

Causes Indicated by Appearances.—Burns of any intensity may be produced by a heated body, according to the degree of the elevation of its temperature and the period during which contact is maintained. The shape and size of the object are often indicated by the burn. These appearances may vary from a simple reddening of the skin to a complete charrring of the parts. At the temperature of the boiling-point, 100° C., metals are capable of producing redness, vesication, and other effects. Partly fused solids cause burns of greater severity than substances which can be readily removed from contact with the body, since, by their adhesion to the skin, they are prone to tear away portions of the derma in their removal. Such burns resemble, in their appearance and effects, those produced by solid bodies. They are less regular in outline, however, and are usually more severe on account of the high temperature of the agent causing them. Burns of this character are characterized as *scalds*.

Boiling water produces scalds which may be so slight as to produce moderate redness only, or be so extensive as to develop quite characteristic effects. Such special effects are an ashy hue of the skin, with a sodden appearance, and the formation of blisters. While these features are usually characteristic of scalds by hot water or steam, they are sometimes with difficulty distinguished from burns by other agencies. Blackening of the skin never occurs in burns caused by boiling water. Gangrene sometimes develops in cases which are not necessarily fatal. Scalding with hot water, though sometimes demanding legal investigation, is usually accidental. Severe and fatal burns of the mouth, fauces, and larynx are occasionally seen, from the inhalation of steam or from swallowing boiling water. These usually occur in children who attempt to drink fluids from teapots or teakettles.

Burning oil produces burns similar to those by molten metals.

Flame causes a scorching of the surface which is characteristic. In burns from this source the hairs upon the injured part are scorched and often upon those parts adjacent. This serves to distinguish burns from this cause from scalds from boiling water or steam, or by boiling oil, or by a hot body.

Petroleum and its derivatives produce burns similar to those caused by flame, but in addition to the scorching the parts burned are blackened and more deeply injured than by flame alone, since the clothing usually holds the burning agent in contact with the body. The odor peculiar to the substance is ordinarily noticeable.

Acids and corrosive agents cause severe burns. Besides injuries accidentally occurring, wilful injuries by the use of such means sometimes require investigation. While no fatal case from this cause is recorded, malicious attacks by throwing "vitriol" (strong sulphuric acid), have occasionally occurred, resulting in loss of sight and severe disfigurement.

The appearances of a burn by a mineral acid are easily distinguishable from those caused by heat. The eschar of a burn by an acid is soft, and sloughs readily, while that caused by heat is hard and tough. Around the site of the burn no redness, blackening, scorching of the hairs, or blisters occur, and the color of the burn is uniform. The stain upon the surrounding parts often affords means of distinguishing the agent which has caused the injury. Sulphuric acid produces a dark brown stain, nitric acid a yellow, and chlorohydric acid a brownish-yellow stain. The clothing also furnishes similar evidence by discolorations, and by a chemical analysis of the fabric. A post-mortem burn by an acid is not distinguishable from an ante-mortem burn, unless a vital reaction has occurred.

Effects of Burns.—These are *local* and *constitutional*.

1. *Local Effects.* Redness, blisters, destruction of the cuticle, scorching of the hair, and roasting of portions of the body occur, according to the extent and severity of the burn. In some severe cases, all these appearances are to be seen on the same body. Within a short time after the occurrence of a burn a special *line of redness* appears between the part burned and the uninjured skin. This *red line* is caused by highly congested vessels and, in some cases, becomes a medico-legal sign of much importance. *Blisters* may be single or multiple; some of these may be unbroken, others may be ruptured and their serum may have flowed out upon the surrounding parts. In some cases the skin, made dry and brittle by the heat, develops *cracks* and *fissures* by the movements of the patient. These most frequently occur in the vicinity of the joints. Occasionally these fissures resemble incised wounds, and it becomes necessary accurately to establish their character. Their depth depends upon the depth of the burn. In the more superficial cases the skin only is fissured, leaving the subcutaneous fat exposed, which may partially melt and flow out upon the sides of the fissure. In such cases the blood-vessels may usually be seen stretching across the crack, not having been destroyed in consequence of their elasticity. They should always be carefully sought. In severer burns the vessels are involved and break with the opening of the fissure.*

Should it become necessary further to differentiate between such a fissure and a wound made by a sharp instrument, the condition of the edges of the fissure, whether clean-cut or ragged, and the presence or absence of uncut vessels and evidences of hemorrhage upon the surrounding parts, will complete the differential diagnosis. It must be remembered, however, that incised wounds and wounds from the action of fire may be found upon the same subject. Each wound noted, therefore, must be specially examined as to all its characteristics of position, depth, shape, and other features.

2. *Constitutional Effects.* The constitutional effects of a severe burn are manifest in the condition of "shock," which is induced by all sudden and severe injuries. The predominating symptoms are pallor, with coldness of the surface of the body, a feeble pulse with chills, and a tendency to collapse. In cases which are quickly fatal, obstructed respiration supervenes, and death from coma follows. Occasionally, convulsions precede death; while

* Casper, "Forensic Medicine," i., 301, 314.

in cases not immediately fatal, a reaction, more or less marked, occurs.

Causes of Death.—Death may follow from cerebral congestion or effusion before any reaction is apparent. Pulmonary congestion and œdema, with pleural effusions, occur in other cases, death supervening before the appearance of any evidences of reaction. Such fatal result usually takes place within the first two days; while, in some cases, the issue is immediately fatal from the prostrating effects of the intense pain. During the two weeks succeeding the infliction of the burn, the period of inflammatory reaction occurs, in which the case may terminate fatally, from the development of inflammatory conditions of the thoracic and abdominal viscera, with or without ulcerative processes in some organ.

Death may be due to one or more of several conditions, arising from important modifications of visceral organs. Such modifications result from the intimate relation existing between the sympathetic nervous system and the spinal cord, and that of the nervous supply of the surface of the body and the internal organs. These changed conditions may induce death *immediately*, or *after an interval*. The conditions immediately fatal are those which cause death by *asphyxia*, through deprivation of air, or by *suffocation* from inhalation of carbon monoxide and carbon dioxide, produced by combustion.

Death may result from *syncope* or *collapse*, induced by nervous shock and pain. A fatal issue, after a short interval, may be caused by *cerebral congestion* and *effusion*; by *bronchitis*, or *pneumonia* with congestion or œdema of the lungs; by inflammation of the intestines, causing *peritonitis* and *ulceration*; by *gangrene* or *septicæmia* or by *exhaustion* resulting from prolonged pain and suffering.

From a medico-legal standpoint it may be necessary to determine the extent of a burn which must, necessarily, prove fatal. While burns and scalds are not legally classed as wounds, they are included among injuries dangerous to life. It must be remembered that upon their *extent*, rather than upon their depth, is the danger dependent. Destruction of a considerable portion of the transpiratory tract, or the suspension of its function by an extensive superficial burn, is far more fatal in its tendency than a deep burn of a limited portion of the body. The character of the burn, whether single and continuous or multiple and in small patches on various parts of the body, is an important consideration. The part affected has a very direct relation to its fatality. Burns of the extremities are less fatal than those of the trunk; while burns of the genitals and the lower portion of the abdomen are especially so.*

The physical condition of the person has a very pronounced influence. Burns in females and children of highly nervous organization, render an unfavorable prognosis necessary. It may be stated that a burn involving two-thirds of the surface of the body is necessarily fatal, but a small area of injury of even one-fourth of the surface has proved fatal. Such a general statement is quite as scientific as an attempt to define an exact area of square inches.

Period at which Death Occurs.—As previously stated, death may occur almost immediately from direct effects, or after a period of five or more weeks. Death, in the majority of cases, occurs during the first five or six days.

How long a person may have survived the infliction of the burn is sometimes a most important question. The probable time which has elapsed is indicated by the presence or absence of suppuration. The development of this condition, if existing, would indicate a period of two days or more, since inflammation and suppuration would not begin, ordinarily, before the third day. Intestinal inflammation or ulcerations, which usually require several days for their development, would also afford suggestions as to the time elapsed.

Post-mortem Appearances.—*Externally*, the examination of a burned body calls for a special note as to the sex, probable age, and every condition bearing upon the identity of the individual. The burned parts should be carefully examined as to the condition and extent of the injury. The presence or absence of redness, blisters, charring, and fissures should be particularly noted and the area of the burned surface carefully computed; as also the relation of the burned portions to uninjured surfaces, and whether the line of separation be sharply marked or gradually fade into the surrounding skin. If blisters are present they should be examined in order to note whether they be full or empty, and as to the character of their contents, whether consisting of a clear or a turbid and colored serum.

Internally, the examination sometimes reveals no lesions, such persons usually dying from shock or from the intensity of the pain. Ordinarily the mucous membrane of the trachea and bronchial tubes is congested and, when asphyxia or suffocation has caused death, dark, sooty or smoky mucus is found in the respiratory tracts. In many cases the serous membranes of the abdomen, thorax, and brain are found to be reddened. The sudden inflow of blood from the surface of the body, caused by the local lesions, also gives rise to peritoneal, pleural, and ventricular effusions.

Should the body have been so badly burned as to be charred or even incinerated, the bony portions usually remain in considerable part, and it is possible to determine the sex from the shape of the pelvis, and to estimate the age from the length and development of the bones and by the lower jaw and teeth. Even if largely reduced to ashes, portions of the bones, sufficient to determine their character, can be detected by careful sifting. Special articles of identity are usually to be found among the ashes. Buttons, articles of jewelry, false teeth and filled teeth, discovered, have been sufficient to establish identification. A chemical analysis of the ashes may sometimes afford valuable evidence, in cases of suspected poisoning, with burning to conceal the crime. While volatile and organic poisons may be dissipated by the intense heat, some agents used in poisoning are not so affected, and might be detected.

When the body is not completely roasted and charred, the possibility of the existence of *wounds* should lead to a careful examination for them, and for fractures of the bones; their accidental occurrence, however, must be remembered. If the body be cremated the evidence of previous violence is destroyed, and an opinion upon the subject could not be formed.

The period of time necessary to cremate the body may become an important question in cases in which such cremation has been resorted to for concealing crime. In the "Druse case" it was definitely ascertained that, in less than ten hours, a human body was cremated in a stove by burning with pine shingles.

Was the Burn Ante Mortem or Post Mortem?—It becomes important to decide, in some cases, whether the burns noted are of ante-mortem or post-mortem occurrence. The decision of this question is largely dependent upon the presence or absence of true *blisters*, since vesication is an almost constant lesion in burns occurring during life. The blister is formed by the separation of the cuticle from the derma by the effusion of an albuminous serum, the surrounding skin being of a bright or coppery red color. The occurrence of blisters may be almost immediate or it may be delayed for many hours, according to the occurrence or non-occurrence of a vital reaction. In cases of shock, or of great depression of the vital powers, accompanying insensibility, death may supervene before vesication can appear. The absence of blisters would not, in such case, be a determining factor.

Blisters are more likely to occur when the burn has resulted from the application of steam, a scalding fluid, flame, or by burning clothing, rather than from the application of a highly heated body. In the living body, if the elevated cuticle of the blister be removed, *a bright red base* is exposed; in the dead body, no red base appears. The blister produced during life contains a yel-

* Tidy, "Legal Medicine," ii., 99.

lowish, highly albuminous serum.* If the blister be unbroken this is present; but if the cuticle be broken evidence of the existence of the blister is found upon the sides and the parts adjacent. The blister produced post mortem usually contains air only, but if its contents are fluid they are not a true serum. The cuticle in such blisters is elevated by the vaporization of the fluids of the tissues beneath it by the heat applied. It is possible in some conditions to produce such blisters immediately after death. Leuret† and Champouillon,‡ succeeded in producing in dropsical subjects, a few hours after death, blisters containing a reddish fluid, slightly albuminous; but such blisters could be distinguished from true blisters produced ante mortem. Wright publishes similar experiences. The experiments of Woodman and Tidy§ lead them to corresponding conclusions, while Chambert, Taylor,‖ Jastrowitz,¶ and others conclude that, while blisters having fluid contents can sometimes be produced within twenty-four hours after death, such blisters lack the essential features characteristic of those produced during life. An extended series of experiments, in this direction, has led the writer to adopt the conclusion that *a true blister cannot be produced post mortem.*

A more important anatomical feature of the burn than the blister is the condition of the skin surrounding the burn. The skin of the burned part appears dry and parchment-like, of a dusky red color, and is surrounded by an area of grayish-white skin bounded by a deeply marked *red line.* The general redness of the burn is transient, disappearing under pressure, but the *red line is permanent* and does not disappear under pressure, and remains after death. This *line of redness* is developed during life, and is essentially a vital process, thus becoming of great significance from a medico-legal point of view.**

Vesication and the formation of the *line of redness* are vital processes, requiring time for their development; yet the absence of these conditions requires a most careful scrutiny of the circumstances attending the burning, as to the existence of shock or profound insensibility, before the adoption of a decision that the burns noted are post mortem.

In cases of multiple burns upon the same body, the question of simultaneous production can be decided by the presence of the same symptoms in all.

Spectroscopic investigation of the condition of the blood in burns thus far has failed to develop constant or purely characteristic appearances. Lack of uniformity in changes noted, in such examinations, and the limited series recorded have not yielded sufficiently positive results upon which to decide questions which may arise.††

Some of the spectroscopic analyses of the blood, in such cases, have shown the presence of dark bands in the spectrum, not encountered in that of normal blood; such bands, however, have not been uniformly noted. Many modifying considerations must be entertained in such examinations, such as the differing intensity of the heat, the length of exposure to it, as well as other elements of variation.

Wertheim‡‡ calls attention to the increased number of leucocytes and the presence of melanin and hæmoglobin. With these observations, those of Hoppe-Seyler agree. Ponfik, §§ on the contrary, is doubtful of the constant presence or the significance of these conditions. Seliger and others have noted appearances similar to those described by Wertheim.

The bright color of the blood observed by Falk ‖‖ and others is contrary to that noted by some observers who have described it as being of a dark, venous hue. These differing conditions may, in some cases at least, be explained by the mode of death. When the fatal issue has resulted from suffocation, caused by the deprivation of oxygen and by the respiration of the products of combustion, the color of the blood would be dark or venous; while in case of death by apnœa, induced by an atmosphere containing an excess of carbon monoxide, the color of the blood would probably be bright or arterial.

Spontaneous Combustion.—The possibility of the occurrence of "spontaneous combustion" of the human body has been occasionally discussed, and a number of cases have been popularly reported. Its serious consideration here, as a scientific fact, is not entertained. The term "spontaneous combustion" is a misnomer. The burning of the body cannot be accomplished without contact with fire.

The possibility of an "increased combustibility" of the human body, under certain conditions, has been recently maintained, and that, under such circumstances, the application of flame causes its rapid combustion. Dr. Hava, of New Orleans, has urged the existence of such a condition.* His experiments on animals and one or two cases observed in the human subject, apparently sustaining his position, have led him to claim the possibility of "an increased combustibility" of the human body, as the result of a gradual, progressive, and constant accumulation of carbon monoxide for many years, and its consequently rapid combustion on exposure to flame.

Enoch Vine Stoddard.

BURSÆ, LIST OF.—A knowledge of the exact location of bursæ is of great importance with reference to diagnosis. Unfortunately the subject has been somewhat neglected by descriptive anatomists. While some bursæ have received names and are accurately described, others are but seldom mentioned, and authors differ as to their nomenclature. In the following list, which has been carefully compiled from various sources, an endeavor has been made to describe and name all the bursæ which have been found in the human body, omitting only those which are merely accidental. The figures show the situation of the principal bursæ in the most important surgical regions.

HEAD.—*Bursa galeæ capitis.* Between the aponeurosis of the occipito-frontalis and the pericranium, directly over the occipital protuberance.[1] Only in aged subjects.

B. sacculi lachrymalis. Between the lachrymal sac and the internal palpebral ligament.[2] Rare.

B. trochlearis oculi. In the pulley of the superior oblique. Constant.

B. capsulæ oculi. Between the capsule of Tenon and the globe of the eye. Usually imperfect. Hyrtl[3] cites cases of effusion into the sac.

B. circumflexi palati (Rosenmüller). Where the tendon of the tensor palati turns around the hamular process.

Bursæ masstericæ. There appear to be several bursæ between the masseter and the subjacent structures. Rosenmüller mentions one between the two portions of the masseter, and one between the masseter and the external pterygoid. Hyrtl[4] mentions one between the muscle and the temporo-maxillary articulation. Nancrede supposes that these may become continuous, and when inflamed form a cystic tumor reaching to the base of the skull.

B. spinæ sphenoideæ. Hyrtl[5] states that when the temporo-maxillary joint is unusually large a bursa occurs between the spine of the sphenoid and the joint capsule.

B. anguli mandibuli. Subcutaneous over angle of the jaw. Rather rare.

B. sublingualis. Between the tongue and the mucous membrane, outside the genio-glossus. Frequently called Fleischmann's bursa, from its discoverer.[6] Some deny its existence.[7] Tillaux has frequently found it, and believes that acute ranula is caused by a rupture of Wharton's duct into it.[8]

B. præmentalis (Fig. 1060). Subcutaneous at lower border of the symphysis of the chin. Quite constant.[9]

NECK.—*B. digastrici posterior* (Rosenmüller). Between the posterior belly of the digastric and the sterno-mastoid.

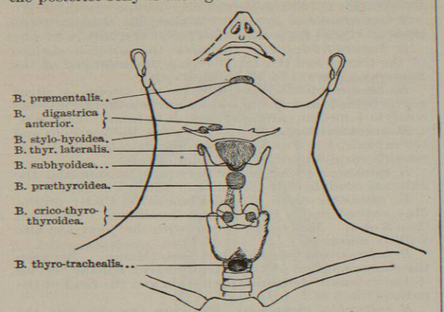

FIG. 1060.—The Principal Bursæ of the Neck, in Front.

B. digastrici anterior (Rosenmüller) (Fig. 1060). Where the tendon of the digastric passes through the fascia binding it to the hyoid bone, or through the stylo-hyoid muscle.

B. stylo-hyoidea (Fig. 1060). Under the insertion of the stylo-hyoid and the hyoid bone.

B. suprahyoidea (Verneuil). Between the upper surface of the hyoid bone and the genio-hyo-glossi. Rare.

B. subhyoidea (Fig. 1060). Between the hyoid bone + combined insertion of sterno-hyoid, omo-hyoid, and stylo-hyoid muscles, and the thyro-hyoid membrane. Larger in men than in women. Often called Boyer's bursa.

B. sterno-hyoidea (Rosenmüller). Between the insertion of the sterno-hyoid and the hyoid bone.[10]

B. præthyroidea (Fig. 1060). Between the skin and the upper part of the thyroid cartilage in old subjects. Often wanting.

B. thyroidea lateralis (Gruber[11]) (Fig. 1060). Between the inferior constrictor and the greater cornu of the thyroid cartilage. Found in five cases out of fifty.

B. crico-thyro-thyroidea (Calori[12]) (Fig. 1060). Between the lateral lobes of the thyroid body and the crico-thyroid.

B. thyro-trachealis (Calori) (Fig. 1060). Between the isthmus of the thyroid body and the trachea. Usually single and median; there may be one on either side. Most common when the pyramid of the thyroid body is well developed, especially when it is attached to the hyoid bone.

B. musculi thyroidei. Between the levator thyroidei, when that muscle is present, and the thyroid body. Calori figures one in a case of goitre.

B. omo-hyoidei. Between the sterno-mastoid and the middle tendon of the omo-hyoid. Mentioned by Nancrede, but not generally noticed by authors.

Bb. aortico-tracheales (Calori). Between the aorta and the trachea. A large one extends from the origin of the innominate to the left carotid, and from the upper border of the arch to the bifurcation of the trachea. A second one is described as posterior to this, also a small one which extends between the left carotid and the trachea. Some one of these was found in thirteen out of forty examinations. If the pericardium extends upward, the large aortico-tracheal bursa is small.

B. vertebræ prominentis. Between the skin and the spinous process of the seventh cervical vertebra. Nancrede states that this is quite large, and may inflame from pressure of a heavy overcoat.

TRUNK.—*B. subclavia* (Rosenmüller). Within the fibres of the rhomboid ligament.[13] Not constant. May simulate a costo-clavicular articulation, of which, indeed, it seems to be the beginning.

B. submammaria. Between the mammary gland and the pectoralis major. Rare, but interesting, as it may be involved in a case of mammary abscess.

B. anguli sterni. Subcutaneous over the angle between the first and second pieces of the sternum. In carpenters and cabinetmakers.

B. hyper-xiphoidea. Subcutaneous over xiphoid cartilage. Usual in shoemakers and rachitic children.

B. suprapubica. Beneath the pubic attachment of the rectus abdominis. Duval[14] reports that inflammation of this has been known to occur as a sequel to croupous pneumonia. Not mentioned by authorities generally. Schreger mentions a subcutaneous bursa at the side of the suspensory ligament of the penis.

B. costæ primæ. Between the muscles of the back and the tuberosity of the first rib. Mentioned by Nancrede. It is probably rare, as the principal authorities omit it.

B. sacralis (Luschka). Over spinous process of fourth or fifth sacral vertebra, or over the articulation of the sacrum and coccyx. Usual in old subjects.

B. coccygea (Luschka). Between tip of coccyx and sphincter ani. Common.[15]

B. phrenico-hepatica anterior (von Brunn[16]). Between the left lateral ligament of the liver and the under surface of the diaphragm in front. Found in 31 cases out of 64. Its enlargement might simulate a diaphragmatic hernia.

B. phrenico-hepatica posterior (von Brunn). Between the same structures behind. Found in 2 cases out of 64.

SHOULDER.—*B. trapezii.* Between the aponeurotic part of the trapezius and the base of scapular spine (3 times in 12, Synnestvedt).

B. latissimi dorsi. Between the latissimus dorsi and the inferior angle of the scapula. Recent observers (Henle, Heineke, Synnestvedt) do not find this.

B. spinæ scapulæ;

B. supracromialis. These are subcutaneous, found in those who carry burdens.

B. infrascapularis. Between the inferior angle of the scapula and the chest wall. Usually between subscapularis and serratus magnus. May be of considerable size, and by crepitation, when inflamed, simulate crepitant râles or pleuritic fremitus.[17]

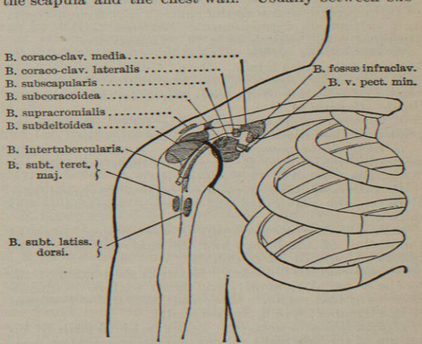

FIG. 1061.—The Principal Bursæ about the Shoulder.

B. subdeltoidea (Fig. 1061). Between the under surface

* Kossack: Friederich's Blätt. f. gericht. Med., 1877, Heft iii., 210.
† Annales d'hygiène, 1835, ii., 387.
‡ Annales d'hygiène, 1846, i., 320.
§ "Forensic Medicine," 1877, p. 886.
‖ "Medical Jurisprudence," Am. ed., 1880, p. 408.
¶ Vierteljahrsch. f. gericht. Med., Bd. xxxvi., Heft i., 1880.
** Casper: "Forensic Medicine," iv., 299.
†† Schjerning-Eulenberg's Vierteljahrs. f. gericht. Med., xli., 44.
‡‡ Wien. med. Presse, 1868, pp. 309-605.
§§ Berliner klinische Wochenschrift, 1876, No. 17; 1877, No. 46.
‖‖ "Die Verbrennungen und Verbrühungen."

* The New Orleans Medical and Surgical Journal, April, 1894.