from the former are shock and injury to a coronary artery. Ninety per cent. are penetrating, and of these only nineteen per cent. are immediately fatal. The right ventricle is most frequently injured, and the left auricle is least so. Auricular wounds are more fatal than ventricular, and injuries to the apex are less dangerous than either. A needle puncture will rarely cause hemorrhage from a ventricle, but excessive bleeding, which is mostly systolic, is liable to follow a like injury to an auricle. A wound inflicted during diastole is less dangerous than a similar injury during systole, perpendicular wounds are more fatal than diagonal, and those of the right heart bleed more profusely than those of the left. The presence of the foreign body in the heart, the size of the wound, the location of the wound, the number of wounds, the connecting cavities, the attending syncope, the involvement of Kronecker's co-ordination centre, are important factors in determining the outcome. Pericarditis, myocarditis, endocarditis, cerebral embolism, and empyema are frequent secondary complications. When the wound heals there is a possibility of cicatricial stretching, and subsequent rupture as in a case reported by Izzo of a man stabbed in the left ventricle, who was conveyed to the hospital from which he was discharged cured on the twenty-eighth day; a few hours afterward, while lifting a heavy body, he fell and quickly died. At the autopsy the cicatrix of the left ventricle was found ruptured. In addition to injuries of the heart caused by bullets, daggers, knives, needles, and various implements of war, it may be wounded by a fractured rib, by a foreign body that has perforated the œsophagus, or by blows upon the chest. Traumatic ruptures are more frequent after a full meal, as the distended stomach pushes the heart upward and forward, and causes a large area of the organ to be in contact with the thoracic wall and receive the impact.

Newton and Gamgee have collected forty-five cases in which traumatisms caused rupture of the heart without opening the pericardium. All were fatal. Only one of Gamgee's cases survived the injury fourteen hours. The fatality is easily understood, for, there being no exit, as soon as the accumulation of blood exceeds the limit of pericardial distensibility, the cardiac movements are mechanically stopped. The surgeon not only would be justified, but it is his bounden duty to operate upon every one of these cases, for it is more important, if possible, to rescue a drowning heart than to relieve a strangulated hernia. It is possible for a foreign body, as a gun missile, to remain quiescent for years in the myocardium, as in the case of a British officer, reported by Stevenson, who carried a bullet encapsuled for eleven years, or the still more remarkable case of Beers (Cincinnati *Lancet Clinic*, 1898), of an American soldier who survived the lodgment of a bullet in the wall of the left ventricle for thirty-seven years.

Symptoms.—There is no certain cardinal sign by which an injury of the heart can be denoted, but when we consider the location of the external wound and the usually profuse hemorrhage from it, if it is large, in connection with other signs and symptoms, it can generally be recognized. The pulse is weak, irregular, and intermittent, and often imperceptible in the extremities. There are pain, pallor, restlessness, and generally dyspnœa. Frequent attacks of syncope are common. The mind is clear but the countenance depicts an anxiety and distress that seemingly would welcome death, with the wintry sterility of the grave, as a sympathizing friend. If there is much blood in the pericardium the heart sounds are indistinct and percussion elicits increased dulness. With the pulsation of the heart a foreign body, as a needle, may be seen to move under the skin, a sign centuries ago enshrined in the magnificence of indestructible verse:

> "He fell, the spear point quivering in his heart
> Which, with convulsive throbbing, shook the shaft."

Treatment.—I presume no one will question the propriety of immediate operative interference, as experience teaches that about thirty-nine per cent. of cases recovered in which the heart had been sutured as against ten per cent. of recoveries in which no operation had been performed. The patient must be kept absolutely quiet. A probe should never be employed, as it is liable to inflict an additional injury upon the myocardium. For temporary hæmostasis some operators have recommended Pean's forceps and various modifications of it, but they all more or less lacerate the myocardium and can never replace digital pressure. Interrupted sutures are preferable in closing a wound of the myocardium. They should not involve the endocardium, and as few as possible should be passed, commensurate with safety against leakage, as they cause a degeneration of the muscular fibre with its tendency to dilatation and rupture. Giordano, from his experiments upon rabbits, concludes that auricular wounds might be closed advantageously with Lembert's sutures. Silk is preferable to any other material. The needle should be the same as that used in suturing the intestines. The sutures should be passed and tied during diastole. If the wound in the heart is sufficiently large a finger should be introduced into it, as Parrozani did, for the double purpose of checking the hemorrhage and to facilitate the passage of the first suture which should be used to steady the heart for the passage of the others. If the pericardial sac is closed either interrupted or continuous sutures may be used. It hardly seems necessary to accentuate the fact of the necessity of perfect cleanliness in these operations whenever the urgency of the case does not require instant intervention, as in the patients of Longo and Ninni. The question of administering an anæsthetic is a mooted one. Ollier says general anæsthesia should not be thought of. Parrozani operated upon his two cases without an anæsthetic, and observed only slight movement when he cut the skin and in passing the sutures in the myocardium. Giordano made the same observation in his case, but thinks Ollier's statement is too sweeping; and if the pulse is strong and the general condition good, chloroform may be administered. Struggling from an anæsthetic is liable to produce detachment of a clot, and renew the hemorrhage, as occurred in Parlavecchio's case. No two operators have made similar external incisions for exposing the heart. Professor Rotter performed a number of experiments upon the cadaver, and concluded that the easiest way to expose the heart was by making an incision four inches in length along the lower border of the third rib, commencing three-fifths of an inch to the left of the sternum. A similar incision was made along the lower border of the fifth rib. The external ends of these incisions were joined by a third. The fourth and fifth ribs were divided and the musculo-osseous flap was turned inward. If more space should be required the third rib could be included. No arteries excepting the intercostal require ligation in this operation. In Parrozani's successful operation an incision through the soft parts one and one-fourth inches from the margin of the sternum, in the fourth intercostal space, was carried for a distance of five and one-half inches, then it descended vertically in the mid-axillary line as far as the superior margin of the ninth rib. The fifth, sixth, seventh, and eighth ribs were cut through, in the mid-axillary line, the incision extending through the pleura. The flap, or door, was raised with the cartilages of the ribs acting as hinges. Parrozani closed the pericardial sac and sutured the flap in position. As the uncleanliness of the weapon and often the urgency of the operation preclude the proper preparation of the patient, it is considered safer to drain the pericardial sac with iodoform gauze as was done in the successful cases of Rehn, Ramoni, and Rosa. There are on record eighteen cases of heart suture and one of ligation of the left coronary artery. Five of these eighteen cases were injuries to the right ventricle and were stab wounds. In two of the cases the surgeons stated that the wounds were one-fourth of an inch and three-fifths of an inch in length. In two cases three interrupted stitches, in two four interrupted stitches were taken, and in the fifth case the wound was closed with a continuous suture of five stitches. Two of the patients recovered. Of the three

unsuccessful cases, broncho-pneumonia caused the death of one on the sixth day, and in the other two cases the operators were not explicit as to the cause of death.

In one patient the left auricle was opened to the extent of four-fifths of an inch. It was closed with four silk stitches. Death occurred on the nineteenth day from abscesses in the lungs.

In three cases the dagger entered the apex, and in two of these it extended into the left ventricle. In these two cases the wounds were respectively three-fourths of an inch and one and a half inches in length; both were closed with four interrupted sutures. The wound which did not enter a cavity was closed with one stitch. All ended in recovery.

There are seven cases of stab wounds of the left ventricle. The length of these wounds varied from three-fifths of an inch to one inch and two-fifths, and required from two to four stitches. Two patients recovered, one died on the operating table of hemorrhage, one in fifteen minutes after reaching the bed, one of pericarditis several days after the operation, and the other two within twenty-four hours, never having reacted.

In two of the cases no mention is made as to the location of the wound. One was a shot and the other a stab wound of the heart. The patient that was stabbed died of empyema on the twenty-second day after suturing.

The left coronary artery was cut and ligated two hours after the injury. The patient had pericarditis and died thirty minutes after the second operation, which was performed on the fifth day for the purpose of drainage. After most of these operations stimulating hypodermic injections were used and hypodermoclysis and autotransfusion practised.

Dr. John B. Roberts, of Philadelphia, in 1881, suggested heart suture, and Dr. Del Vecchio, of Naples, in 1894, demonstrated its feasibility before the Eleventh International Medical Congress in Rome, by his experiments on dogs. Two years later the human heart was sutured by Farrina and Cappelen. It is surprising to find the statistics collected by Fischer, of Breslau, in 1868, quoted as late as 1901 as authoritative in computing the prognosis in this class of injuries.

The successful suturing of the heart by Rehns, Parrozani, Parlavecchio, Pagenstecher, and others has revolutionized the treatment and changed the probable outcome. Fischer's statistics, though a monument to his untiring zeal and energy, are now like an antiquated signboard on a discarded highway; but

> "Faith, fanatic faith, once wedded fast
> To some dear falsehood, hugs it to the last."

Luther L. Hill.

HEAT, ANIMAL.—See *Calorimetry*.

HEAT-STROKE.—(Synonyms: Sunstroke, insolation, thermic fever, *siriasis*, *coup de soleil*, *coup de chaleur*, *Hitzschlag*, *Sonnenstich*, *ictus solis*, *insolatio*.)

Definition.—Insolation is a disease whose main features are, in its milder forms, intense exhaustion, with or without rise of temperature, and in its severer forms, with an enormous rise of temperature and coma probably caused by acute auto-intoxication due to the presence in the blood of toxic decomposition products or toxic substances produced at the unusually high temperature, the exact nature of these substances being at present unknown.

From the time when it is recorded that Elisha restored the Shunammite woman's son to life after a sunstroke the frequency of this affection has often been noted. Armies at times have been almost decimated by it, especially when operating in sub-tropical or tropical countries. Sunstroke occurs most frequently in the tropics, particularly where the climate is damp. In the United States it occurs during summer in the Mississippi Valley, around the southern shores of the Great Lakes, and especially along the Atlantic coast. In the Western and Southwestern States it is rare, owing to the dryness of the climate.

Any cause that diminishes the resistance of the body predisposes to sunstroke. Alcoholism is undoubtedly the most frequent predisposing cause, not only chronic alcoholism but even a single excess. All causes producing extreme fatigue, such as severe muscular exertion and sexual excesses, predispose to an attack. Elderly people suffering from chronic ailments and invalids of any age, even if taking no bodily exercise and remaining indoors, are sometimes overcome by the heat and suffer true attacks of heat-stroke. It is not so common amongst children as amongst adults. Men are more frequently attacked than women because their occupations more often subject them to different forms of exposure to heat and require of them greater physical exercise, and because men are more often given to alcoholic excess than women.

Exposure to the direct rays of the sun is usually the exciting cause, but this is not necessary; some of the worst epidemics in the tropics have occurred during the night. While soldiers on the march and laborers working in the sun have given the greatest number of victims to this disease, men working in superheated environment such as firemen, stokers, and laundrymen have often been attacked. The main factors in the weather which are specially prone to assist in the causation of insolation are high humidity with continuously high temperature and lack of motion of the air. Humidity and especially the absence of cooling breezes are as important factors as is high temperature, although the cause of sunstroke is usually attributed to the high temperature alone. It has long been noticed that a hot, sultry, lifeless atmosphere is the one in which most cases of sunstroke occur. Impurity of the atmosphere is not unimportant, as is shown by the fact that men sleeping in crowded barracks or small tents are more often victims than those in well-ventilated quarters.

Sunstroke occurs with greater frequency in the tropics amongst unacclimated individuals than amongst those of long residence, who have acquired a certain amount of immunity to the effects of heat. This immunity, however, is by no means absolute, as even the natives of India, Egypt, Arabia, and Africa are at times overcome. The light-skinned races are more susceptible than the dark-skinned.

Pathological Anatomy and Pathology.—The post-mortem appearances depend on the time that has elapsed since death occurred. When the post-mortem examination is made shortly after death the following conditions are usually present: When the ante-mortem temperature has been high the viscera feel noticeably hot; the lungs are congested, often extremely so; the liver is large, and the abdominal veins are filled with blood and there is intense congestion of the brain and meninges. The left ventricle of the heart is contracted and empty; the right ventricle is filled with semi-fluid blood, sometimes giving an acid reaction. Rigor mortis has set in early. When several hours have elapsed since death decomposition has rapidly set in. The heart, instead of being contracted, is then flabby and filled with grumous, semi-fluid blood. The spleen is slightly enlarged and soft. The meninges of the brain are congested, and there is more or less abundant subpial fluid. The brain itself is usually firm and not congested, with sometimes a little bloody fluid in the ventricles. The membranes of the spinal cord are congested, the cord being firm and about normal in appearance. Small hemorrhagic extravasations are sometimes found in the viscera, pleuræ, and pericardium. The most constant changes seem to be marked congestion of the meninges and viscera, the fluidity of the blood, and the unusual rapidity with which rigor mortis and decomposition supervene.

In the minute cellular structure of the brain we find changes which are much more constant and which are fairly characteristic. Dr. Ira Van Gieson, of New York, has described these lesions in the neurons of the brain and cord, as an acute parenchymatous degeneration of the ganglion cells best shown by the Nissl stain and counterstain with eosin. In the normal cell stained in this manner the chromophilic plaques, or Nissl bodies,

appear to have a somewhat barrel-stave shape and to be somewhat thickly packed in the body of the cell. In insolation the appearances are strikingly different. In the early stages of degeneration the chromophilic plaques are divided into large and small segments, and in other places appear fused together in a confluent condition, and they show changes in form, having rounded ends or are oval or spherical, and are abnormally few in number. In other cells the chromophilic plaques show further disintegration, and have been converted into fine, dust-like particles strewn about over the cytoplasm, giving it a finely granular, almost homogeneous appearance. The outlines of these cells are much less distinct than normal. These appearances seem to be more often found in the anterior horns of the spinal cord, where the changes do not seem to have advanced so far as in the cerebral cortex and cerebellum. When the changes are further advanced the chromophilic plaques are not only converted into dust-like particles, but in some cells the particles have disappeared, giving to the cell body a pallid, shadowy outline. The changes in the nuclei may also be marked and radical. The nuclear membrane is uneven in outline, notched in places, and slightly crenated; the nuclear fluid is changed in consistence, so that it appropriates methylene-blue stain very freely. This is in distinct contrast to the normal. In some cells the nuclear contents appear homogeneous, while in others there is a fine granular content. In some cells the nucleus seems to have entirely disappeared. In none of the ganglion cells of the cerebral cortex, cerebellum, and spinal cord which have been examined, has there been any distinct evidence of destruction of the cells. There have been no vacuoles nor loss of substance in the cytoplasm. The cells preserved their form, with the exception of the various phases of dissolution of the chromophilic plaques. In the cerebral cortex these changes occurred in both motor and psychic cells.

The changes thus described are simply those produced by the operation of a great variety of poisons, as lead, alcohol, the microbic poisons, and auto-intoxications. It is therefore evident that a chemical reaction has occurred between the poison and the constituents of the cells. By the method of elimination and excluding other groups of poisons, these changes having been found in the nervous systems of patients in whom alcoholism can be positively excluded, it is justifiable to conclude that the lesions found in cases of insolation are from some kind of auto-intoxication. This toxic resolution of the ganglion cells may not necessarily go on to destruction of the cells.

Recently L. W. Sambon has brought forward the idea that sunstroke is due to microbic infection, basing his opinion on the fact that the cellular lesions cannot be distinguished from those of microbic infections, and upon the symptoms, relapses, its peculiar geographical distribution, epidemic outbreaks, condition of climate and soil under which it prevails, and the relative immunity by acclimatization. He has given the name of "*siriasis*" to this disease.

The explanations of these reasons, advanced by this author, do not seem to be sufficient to justify this opinion, and the history and circumstances under which the various epidemics have occurred point strongly against the microbic origin.

The changes in the cells of the other viscera also seem to be those of acute parenchymatous degeneration. These are especially noticeable in the liver and kidneys. The blood in sunstroke also undergoes certain marked changes. The number of red cells seems increased, but this is probably only apparently due to the condensation of the blood from loss of fluids through excessive sweating. The hæmoglobin in twelve cases gave from eighty-five to one hundred and twenty-five per cent., averaging one hundred per cent. The increase above the average normal was probably also due to blood condensation. There seems also to be destruction of the red cells, as the leucocytes are found to contain pigment. The pronounced anæmia following sunstroke also bears out the destruction of the red cells. These blood changes occur not only in patients who have suffered from hyperpyrexia, but also in those whose temperatures do not rise above 105° F. As the red cells do not disintegrate from heat until the temperature rises to 125–129° F., the destruction observed in insolation points definitely to some toxic elements in the blood. The blood serum of sun-stroke patients has also been shown to be exceedingly toxic to animals. Levene and Van Gieson found that 9 c.c. injected into the ear veins of rabbits killed the animals in less than an hour, normal human serum having no such effect.

The gases in the blood, however, seem to remain normal. Wood and other observers have reported that the alkalinity of the blood in individuals dying of sunstroke is greatly diminished, and in some instances the reaction is distinctly acid. Levene and Van Gieson have also found that the urotoxic coefficient was diminished in the urine of sunstroke patients, while it was increased in the urine of the same patients during the first twenty-four to forty-eight hours of recovery. This seems to point to failure of elimination of toxic substances during sunstroke. Arloing has found that the sweat during severe muscular exercise is two or three times more toxic than that of the same individuals at rest. When sweating ceases in sunstroke there would seem to be an accumulation of these toxic substances.

Based on the above lesions and experimental observations, the clinical symptoms of the various forms of sunstroke are more readily explained and understood than by the theory that heat alone within the body was the sole cause. The changes in the cytoplasm in the ganglion cells show the injury to the functional activity of the cell, while the changes in the nucleus show processes detrimental to cell life.

The prodromal symptoms of the severe forms of sunstroke are those of severe functional disturbance, while the later symptoms of the severe forms show a tendency to destruction of the neurons. Heat undoubtedly is the main contributing cause of sunstroke, as exposure to cold is of pneumonia. From whatever source the heat comes the action on the body is practicallly the same.

The even temperature of the normal body is maintained by the maintenance of the equilibrium between heat production and heat loss. Young persons with healthy eliminative organs will stand a high degree of temperature and long exposure to the effects of heat. Equilibrium is secured by the contraction and dilatation of the skin capillaries and increase and decrease of perspiration, with the consequent increase and diminution in radiation and conduction of heat over the body. There are also said to be nervous centres controlling the production of heat, but their exact location and action are not fully determined.

Heat is produced in the body by chemic metabolism constantly acting, especially during muscular exercise. Normally 2.6 per cent. of heat is lost from warming food and drink ingested; 2.6 per cent. by warming the inspired air; 14.7 per cent. by evaporation; and 80.1 per cent. by radiation and conduction through the skin.

Sunstroke occurs with greatest frequency among persons performing some form of bodily exercise in an intensely hot environment. The heat production of the body is thus at the maximum, while the heat loss from warming the inspired air is zero. The loss from radiation and conduction is also zero, the air being as warm as or warmer than the body. If sweating is excessive heat loss may be sufficient to maintain the equilibrium; but if sweating ceases, as it usually does in insolation, heat loss ceases and heat production continuing, the heat rapidly accumulates in the body, and thus an enormously high temperature is brought about.

Goldscheider and Flatau have shown that the neurons of the central nervous systems of animals whose temperatures have been artificially raised to 109.4° F. seem to show the same changes when stained by the Nissl method as those described above. The neurons of living animals whose temperatures have remained for three hours at 107–107.6° F. also began to show the same changes.

But when the animal had been previously killed and the temperature of the body raised to 112.3° F., the cells did not change. Heat alone, therefore, will not produce these changes, and the action must be one of chemical metabolism in the living cell protoplasm. In sunstroke patients at times die, the temperature never having gone above 106°. This temperature in other diseases of microbic origin is borne without causing death, hence the amount of heat *per se* in the body does not cause death in these cases of sunstroke.

Most authorities state that a temperature of 113° F. is necessarily fatal, but a patient suffering from sunstroke was admitted to the Presbyterian Hospital, in New York, with a temperature of 115° F., and recovered. The limit of temperature which can be borne by the body with recovery can, therefore, not be definitely stated. In infectious diseases it is the lesion produced by the causal agent and not the temperature which kills; in sunstroke it is the metabolic changes in the central neurons and not the heat.

As to the definite cause of death in sunstroke, many theories have been advanced. Sudden coagulation of the cardiac muscle due to heat does not seem a tenable theory. While it is true that on the battlefield men have been known to drop from sunstroke and become rigid, dying almost instantly, heat coagulation of the heart muscle does not occur below a temperature of 122° F. or higher, while many patients die long before such a temperature is even approached, and the highest temperature ever recorded in sunstroke is 117.8° F. Death is also not due to lack of conduction in the nerve fibres, as these do not lose their power of conduction to impulses until a temperature of 125.6° F. is reached. It would therefore seem to be due to some toxic action on the cardiac and respiratory centres at whatever temperature this action may occur. In the most accurately recorded experiments on animals respiration ceased before the heart. Clinically there seems to be simultaneous failure of heart and respiration, but at times first one ceases, then the other. As will be seen later, the prodromal symptoms of insolation are those of disturbance of the digestive tract and liver. Food is badly assimilated, there is indigestion in the stomach and in the intestines, and sometimes slight jaundice. Abnormal substances are thus produced in the digestive tract and liver. This causes headache and malaise. When severe muscular exercise adds its decomposition products to the circulation and at the unusual high temperature of the blood, abnormal chemic changes may take place.

The milder forms of sunstroke known as heat prostration, or exhaustion, are therefore due to a mild form of auto-intoxication, and are but the prodromal period of the severe forms, the neurons being but functionally disturbed. If the intoxication is more severe, syncope and unconsciousness occur. Heat loss due to great dilatation of the skin capillaries is sufficient to prevent accumulation of heat. Heat loss may be so pronounced and predominate over heat production that lessening of temperature may occur. When the intoxication is very severe unconsciousness may develop suddenly with or without prodromal symptoms, and the vaso-motor, cardiac, and respiratory centres are affected. Heat loss being abolished, and heat production and accumulation being at a maximum, an enormously high temperature is developed. The neurons are so severely poisoned that their functions are abolished and convulsions, delirium, coma, and death supervene.

Symptoms.—The mildest form of sunstroke is heat prostration or exhaustion. An unusual weakness following exertion in hot weather most often seen in feeble persons is probably the mildest form that occurs. In more vigorous individuals the symptoms of this form are more pronounced. Exhaustion may come on suddenly without prodromal symptoms, or there may be prodromal symptoms followed by complete exhaustion. There are usually headache, dizziness, pain in the back and legs and epigastrium, with sometimes tingling of the hands and feet. These symptoms may continue for a few hours or for three or four days, and are sometimes accompanied by anorexia, nausea, and vomiting, or there may be diarrhœa or constipation. Some patients show slight jaundice of the whites of the eyes. Uncommonly in this form of sunstroke perspiration may cease. While the patients are suffering from the prodromal symptoms they may be able to sleep and awake refreshed, but as soon as they attempt to go about their usual occupations after a varying length of time the prostration becomes so extreme that they are forced to give in to it. The headache is intense, either frontal or occipital, and the patient seems dazed; consciousness is retained. The respirations are slightly different from normal, 24 to 28 per minute. The pulse may remain normal in frequency, or, depending upon the intensity of the exhaustion, it not infrequently runs as high as 130 to 140 per minute. It is, however, of good force and tension. The temperature may be normal or even slightly subnormal, though as a rule there is a rise and the temperature may reach 104.8° F. Under proper treatment the temperature may become normal in a few hours, the other symptoms abate, and the patient rapidly recovers, or the symptoms may continue and there may be a slight thermic fever for two or three days, even a week, the temperature ranging from 99° to 103° F., gradually falling to normal. Cases have been observed in which a slightly elevated temperature has been maintained for fifteen days.

In moderately severe cases there is always loss of consciousness, but the temperature does not reach the hyperpyrexial level of 105° F. The same prodromal symptoms may be present as in the mild form, and at other times there is an intense feeling of burning and heat and "pins and needles" in the head. Sometimes there are alternating hot and cold flashes over the body with sweating. Vomiting and anorexia are often severe. Perspiration may cease a short time before unconsciousness occurs. Just before loss of consciousness there are noticed in some patients sudden dizziness and dyspnœa, sometimes with chromatopsia. In other patients there is no premonition of the attack.

These symptoms may occur while the patients are at work or they may be suddenly overcome while quietly walking in the street at night. Suicidal tendency is sometimes developed just prior to loss of consciousness; sailors have been known to try to throw themselves overboard, soldiers to attempt suicide with their rifles. This temporary mental aberration may continue for a week or two, and then be followed by complete recovery. In some cases of this class there are, with the loss of consciousness, symptoms of complete collapse. Wood reports a case with a temperature of 95° in the mouth. Temperatures of 96–97° are not uncommon. The majority of these patients, however, show a rise of temperature between 101–104°. Except in cases of collapse the pulse is full and of good force and tension, though it may be as high as 130 per minute. Respirations may be normal or as frequent as 40 a minute, being usually shallow, the stertorous breathing of the severer forms is not present.

Physical examination will show coated tongue, skin hot and dry or covered with profuse sweat, and the patient may be conscious or totally or partially unconscious. The pupils react to light slowly and are sometimes dilated. Slight convulsive movements may be present, or there may be a restless delirium with moaning and groaning. Not infrequently there is a peculiar dark-pink, petechial rash on the body, different from the ordinary prickly-heat rash.

The changes in the blood enumerated above occur in this form of sunstroke as well as in the hyperpyrexial form. Unconsciousness, delirium, and other symptoms may persist for a few hours after the cold bath; sometimes consciousness is not regained for twenty-four hours.

Thermic fever when present persists for several days or a week. Patients usually recover from this form of sunstroke. This degree of insolation seems to be the least common. In two hundred and twenty-four cases