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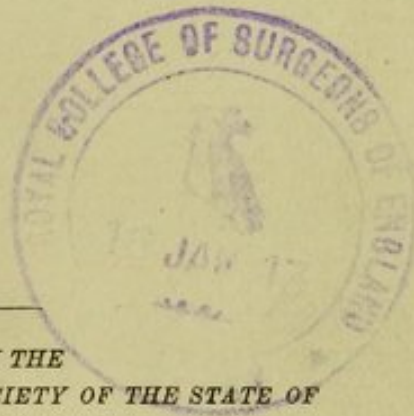
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ON SURGICAL SHOCK.

BY

JOHN H. PACKARD, A.M., M.D.,

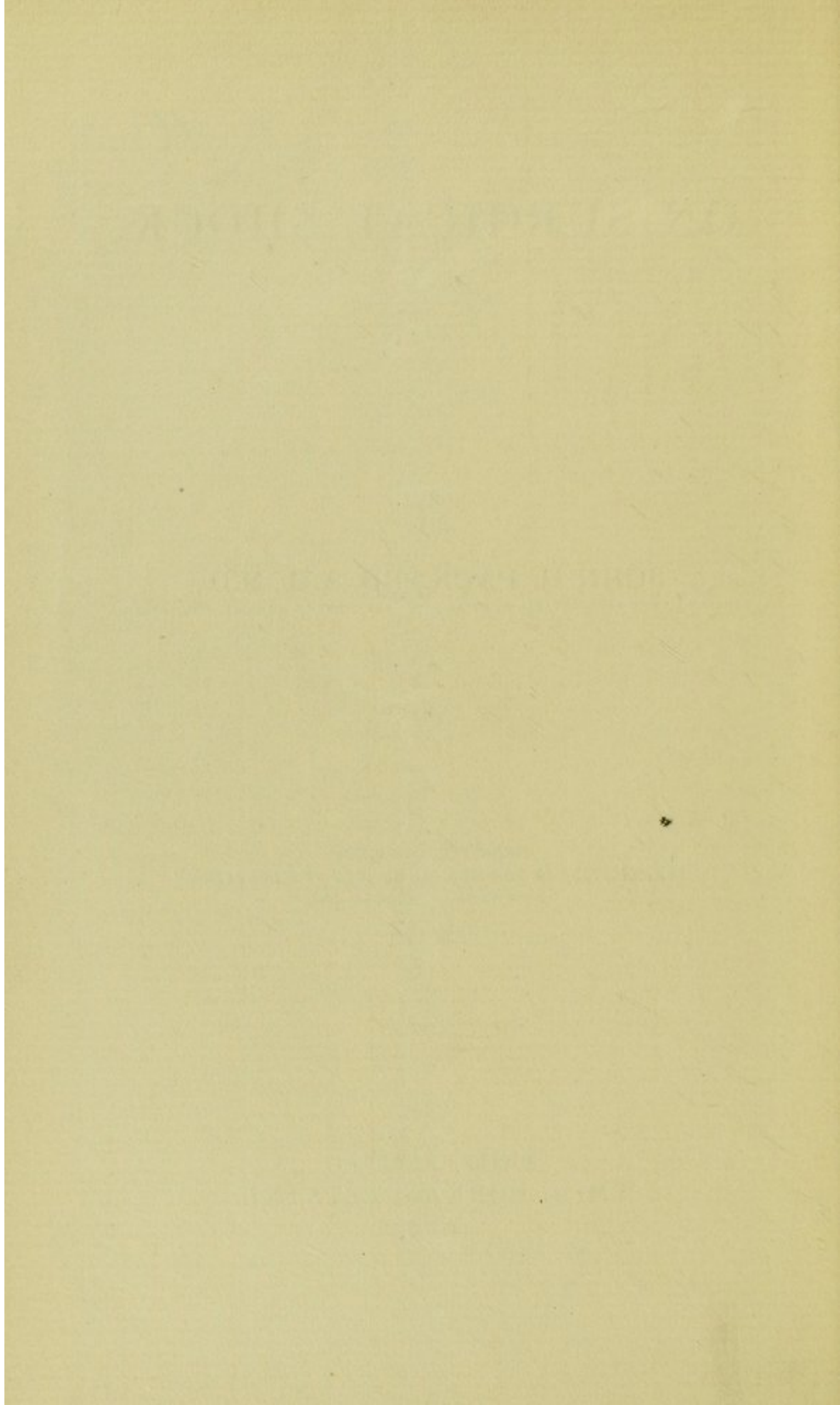
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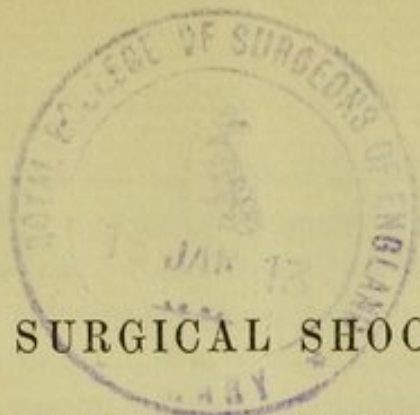


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ON SURGICAL SHOCK.

BY JOHN H. PACKARD, M.D.,
PHILADELPHIA, PA.

THE terms "shock" and "collapse" are very often used interchangeably, although they really are not so. The word "shock," derived, according to lexicographers, from the verb to *shake*, conveys in itself an idea of suddenness and of damage from without. "Collapse," on the other hand, signifies a falling together or falling in, as of a building weakly constructed. The phenomena of the two conditions are similar in that they both consist of sudden and more or less marked prostration. And it may be correctly said that a man, under the shock of an injury or an operation, falls into a state of collapse. But collapse occurs, also, as the result of causes not properly coming under the head of shock, as, for example, in cases of cholera, of peritonitis, of internal hemorrhage, of certain animal poisonings, etc.

Dunglison's *Medical Dictionary* (edition of 1874) defines *shock* as follows: "Sudden or instantaneous depression of organic, nervous, or vital power, often with more or less perturbation of body and mind, passing either into reaction or fatal sinking, occasioned by the nature, severity, or extent of injury, or by an overwhelming moral calamity." This definition he credits as quoted from Coupland. As synonyms of shock, Dunglison gives "Vital Shock, Vital Depression, Nervous Depression, Fatal Sinking." He also refers the reader to "Concussion," under which head he says: "In surgery it is used for the agitation often communicated to one organ by a fall upon another; as to the brain from a fall on the breech, etc. In all severe injuries, in sudden encephalic hemorrhage, and in overwhelming emotions, a concussion or shock is felt to a greater or less extent in the nervous system, which requires the careful attention of the physician." Of *collapse* the same authority gives the following definition: "A complete prostration of strength, either at the commencement or in the progress of a disease."

Billings defines "shock" as "the nervous exhaustion and depression of the heart's action caused by a wound or injury;" and "collapse" as "great and comparatively sudden prostration, with paleness, coldness, and very feeble pulse."

Gould defines "shock" as "the depression or grave effect produced by severe injuries, operations, or strong emotion;" and "collapse" as "extreme depression and prostration from failure of nervous force, as in cholera, shock, hemorrhage, etc." He further gives "secondary or insidious shock" as "a second attack occurring after the first."

It will be noted that while neither of these definitions is beyond criticism, the idea of an external disturbing influence as implied in the word "shock" has been clearly entertained by each of these authorities.

The word *shock* has been adopted into the medical nomenclature of France, Germany, and Italy, probably on account of its brevity and significance. The French word *ébranlement*, or shaking, like the German *erschütterung*, is much longer, and has a colloquial meaning which makes it less available. I do not know what the Italian word is which has given place to it.

Both terms, "shock" and "collapse," always imply an element of suddenness. It seems to me that there is a certain incorrectness in the use of the term "secondary shock." When a man sustains an injury, or undergoes a severe surgical operation, there is a greater or less degree of shock perceptible. If the tax upon his powers of resistance has been very great, reaction may partially occur; but when his reserve force is exhausted, he sinks again into a state this time of collapse. We sometimes see, under the same conditions, a partial reaction, and then a steady decline of power for days or weeks, the patient growing gradually weaker and weaker until he dies exhausted. Here the element of suddenness is wanting, and the term "collapse" cannot be properly employed in describing the process.

It is a singular fact that the recognition of the state of shock, as a distinct condition attendant upon severe injuries and surgical operations, dates back less than sixty years. Yet the phenomena, to the sum of which we give this name, must have been open to observation in all ages. We cannot suppose that the vast building operations of the ancients, in Egypt, in the East Indies, in Greece, and Rome, were carried on with never an accident; and although

the mechanical appliances used in those stupendous works are unknown to us, we may be sure that a laborer on the Pyramids, who had the misfortune to have a leg or an arm crushed, must have presented much the same symptoms as would a workman on one of our railroads under like circumstances. We do, indeed, find some reference to this matter by some of the older writers. Heister says: "Gunshot wounds, though in the strongest constitutions, generally produce the worst of symptoms, as excessive weakness, faintings, tremors, palpitations, convulsions, hiccoughs, etc., after which succeed instantly dangerous fevers, nauseous vomitings, and the like." And again: "Amongst the many terrible symptoms attending these wounds, the first is an excessive languor, which is soon followed by fainting fits, partly occasioned by the hurry of their spirits, and partly by the effusion of blood."

Clearly as this passage indicates the state in question, it was written at a time when isolated facts were noted, without being grouped and generalized so as to develop principles. And, indeed, in that day the opportunities for observation afforded to individual surgeons must have been limited, as was also the intercommunication of ideas. In military and naval practice shock was observed as the effect of gunshot wounds, and was supposed to be peculiar to this form of injury; but it is scarcely more than incidentally referred to by them.

Early in the second quarter of the present century the development of steam-power, and the consequent multiplication of machinery, while adding greatly to the comfort of human life, increased in a corresponding degree its risks. With the growth of population everywhere, there came to be vastly greater numbers of people engaged in dangerous occupations, and accidents became far more frequent. To take one example only: The recent report of the United States Commerce Commission states that 20,025 persons were injured on the railways of this country during the last year, while 6,334 were killed. Among railroad employés, one in 33, or about 3 per cent., were injured. When we consider besides these the risks of factory-workers and miners, and all those of ordinary life, it is not strange that severe injuries are far more commonly observed by the surgeons of our own day than by those of any former period. Along with these increased opportunities for observation, there has come a vast increase in the number of observers and in the means of interchange of facts and opinions; and this

naturally led to the grouping of phenomena, and their arrangement under appropriate headings or names.

So far as I can ascertain, the first essay on the subject of shock was published in 1834 by a French surgeon named Delcasse. He called it "commotion;" and this word is still very often employed by surgical writers in France. Hellge, a German, followed in 1839, using the same term. Sir Charles Bell, in 1840, spoke of "commotion from severe wounds," quoting from Travers a case of gunshot wound, and from Sir Astley Cooper one of a crushed knee, giving a good description of shock. The earliest American writer upon the subject was E. S. F. Arnold, of New York, who published in 1863, in the *American Medical Times*, a paper "On the Uses of Opium in Managing the Shock and Reaction of Surgical Injuries."

A notable paper by an English surgeon, Mr. Morris, "On Shock after Surgical Operations and Injuries," appeared in 1867, and attracted general attention to the matter, which from that time was recognized as one to be formally treated of in systematic works on surgery.

CAUSES.—Shock is probably seen by surgeons most frequently as the result of railway accidents, or in manufacturing districts in injuries by machinery, and in mining regions in those due to explosions. Injuries to the spine would seem to occur very often among lumbermen, and are always followed by severe shock. The unfortunate abundance of firearms has made us all unduly familiar with gunshot wounds and their effects. Burns are apt to be followed by very severe shock, in proportion rather to the extent of surface covered by them than to their depth or to their situation. As a general rule, whatever the character of the injury, the nearer it is to the trunk, and the severer the damage, the more marked and the more prolonged is the ensuing shock.

Shock sometimes follows blows, as, for instance, upon the epigastrium, in which there is no evidence of lesion. Goltz found that, by striking sharply on the abdomen of a frog, the action of the heart was paralyzed. The blood seemed to stagnate in the vessels, and very little passed through the heart. This effect he ascribed to the paralyzation of the vasomotor nerves, which in the frog are distributed, he says, to the veins as well as to the arteries. Violence done to the testicles in man has been known to bring on intense shock, and even death.

According to Savory,¹ "Shock is the paralyzing influence of a sudden and violent injury to nerves over the activity of the heart." Brunton thinks the impression on the heart is produced through the vagus nerve, and this seems very probable, although difficult of demonstration. As seen in man, shock would appear to be essentially a condition of the nervous system, and especially of the cerebro-spinal axis.

An element which is very often a potent factor in increasing the degree of shock after injuries is the loss of blood. Severe shock may, indeed, be present, as in many cases of railroad crush, when there has been little or no hemorrhage; but when there has been free bleeding, all the symptoms of shock proper are aggravated, and the chances of the patient's reacting are materially lessened.

Exposure to cold, as during transportation to hospital, too often adds greatly to the shock of an injury. Unfortunately, it must be confessed that, from the inattention of the surgeon and the carelessness of his assistants, patients are sometimes subjected to this disadvantage during the performance of grave operations.

SYMPTOMS.—With the symptoms of shock all surgeons are probably in a general way familiar. The patient lies relaxed and helpless, his face and lips pale, his surface cool and bathed in clammy sweat, his eyes dull or unnaturally bright; he may for a time lose consciousness, and his mind afterward be either dazed, torpid, or frightened. This fright, which sometimes amounts to actual terror, has by some been assigned as a cause of the other symptoms; but it may not exist at all, and is often out of proportion either to the severity of the injury received or to the gravity of the other phenomena manifested. Especially when there has been free bleeding, there is extreme pallor, dilated pupils, yawning, thirst, perhaps nausea; the face is pinched and shrunken; sometimes the mind is wandering. Often there is no complaint of pain, apparently because the sensitiveness of the nervous system is blunted by the intensity of the shock it has sustained. In the former of these conditions the pulse is apt to be thin and corded; in the latter soft and compressible; in both it is usually very rapid. Respiration is shallow, and there is frequent sighing. Hiccough is sometimes very troublesome. Paralysis of the sphincters, especially of that of the bladder, is very commonly observed.

¹ Holmes's System of Surgery.

Occasionally we see a different condition, answering to that described by Travers as "prostration with excitement." The pupils are contracted, the skin dry and not markedly cool; there is dyspnoea and oppression, thirst, and frequent sighing; tossing movements of the arms and head, with general restlessness and tremor; the mind is anxious and perturbed, sometimes decidedly wandering.

From a condition of this kind the patient may pass into the more ordinary form of collapse. Or, which I believe is less common, prostration with excitement may occur as a partial reaction from collapse. But indeed, and this seems to me an important point, the state of shock or collapse is not always a uniform one; the condition of the patient may fluctuate between better and worse many times before its final issue is determined. Often what is called "secondary shock" would, I think, be more properly described in this way as a mere aggravation of symptoms already existing. There is one point upon which something more definite is required than has yet been given here, and that is as to the temperature in shock. Anyone can perceive that the skin is cold; but we all know that this cannot be relied upon. I have been present when a patient of mine was seized with a chill, attendant upon a suppurative pelvic cellulitis; her hands were cold, but the thermometer under the tongue ran up to 105° . We find, however, that in cases of surgical injury or operation the condition of shock is attended with an actual lowering of the temperature. From the records of my service at the Pennsylvania Hospital I may be allowed to cite a few instances:

CASE I.—A man, aged twenty years, had been struck by a locomotive; fracture of the base was suspected. His temperature on admission was 95° , but went up in an hour or two to 99° . During eight days it varied, sometimes going as high as 101.8° ; just before his death it ran up to 103.4° .

CASE II.—A man, aged thirty years, with a crush of the lower part of the thigh by a cable car running over it, had lost much blood; his temperature was 96.4° ; reaction ensuing in three hours, amputation was performed, the thermometer then showing 99° , and going up to 100.4° ; it fell to 100° , and death ensued three hours after operation.

CASE III.—A boy, aged eighteen years, was struck by a wagon-pole, and had a compound comminuted fracture of the femur, patella, and tibia, with laceration of the vessels. His temperature on admission was 96.2° ; it rose to 98.2° , then fell to 97.4° , and then rose to 102.4° before his death, twenty-four hours after the injury.

CASE IV.—A man, aged thirty-four years, had a complete railroad crush

of the leg, the bones being finely comminuted. His temperature was 94° , his pulse 160, his respirations 45. In two hours his temperature rose to 98° , but his other symptoms did not improve; he died about twelve hours later.

CASE V.—A man, aged thirty years, was caught between two cars, and had great contusion of the abdomen, genitals, and thigh. On admission his temperature was 94.2° ; in two hours it went up to normal, then fluctuated between 99° and 101.6° ; on the twelfth day it ran up to 104.8° ; then gradually came down, and was normal until his discharge about four weeks afterward.

Sometimes the degree of lowering of the temperature in very severe injuries is remarkably small.

CASE VI.—A man, aged thirty-six years, with a suicidal pistol-shot of the right parietal region, the ball penetrating and lodging in the brain, with a number of fragments of bone, some of which were removed by trephining, had a temperature of only 97° ; for two days it gradually rose to 100.8° ; then down for twelve days to nearly normal, then became subnormal, and so remained for nine days, and then went up to 102.8° ; it is now, and has been for five days, a little above 100° .

CASE VII.—A boy, aged seven years, was severely burned about the abdomen and thighs; his temperature was 97.4° on admission, but in a little over twenty-four hours rose to 104° , then fell to 101° , and on the third day to 99° ; it then ran up again just before his death to 104° .

The temperature does not always fall in cases of shock, at least in burns. Not long since two children were brought into my ward within an hour, each one extensively and fatally burned; one had a temperature of 104° , the other 104.2° .

Now as to the effect of operations:

CASE VIII.—In a case of disease of the hip, in a boy aged six years, I excised the head of the femur. Just afterward the temperature was 97° ; in nine hours it had run up to 102° ; it fluctuated for two days between 101° and 103° , remained for two days in the neighborhood of 102° , then ran up to 105° without obvious cause, and then came down to 99° , where it has remained for three days.

CASE IX.—On the 25th of November last I excised the knee-joint of a boy, aged eleven years, for gelatinoid degeneration. The boy had been in the hospital for two weeks, with a temperature constantly at 99° or 100° . Just after the operation it was 95° ; it went gradually up to 100.6° ; stayed at that for eleven days, then went down to normal, and remained so for five weeks, when it was no longer noted, the boy being about the ward, and practically well.

CASE X.—A week after the above-mentioned operation I excised the knee of a colored man, aged twenty-three years, for similar disease of long standing. His temperature never fell at all; it was 99.6° just before the operation, and 99.8° just after it.

CASE XI.—About ten days ago I opened the colon in the left loin in a woman, aged forty-six years, on account of malignant disease of the uterus which had ulcerated into the rectum. Her temperature just before the operation was 99.1° ; just afterward it was 97.4° ; twelve hours later it had risen to 101° , but soon fell again to normal.

CASE XII.—The lowest temperature I have found recorded at the Pennsylvania Hospital was in the case of a man aged fifty years, who was found unconscious in the street, having fallen in a slight apoplectic attack, as was supposed. He had been lying in the cold, and on admission his temperature was found to be 92.6° . Reaction took place within twelve hours, and complete recovery ensued.

The above data have been obtained on no special system, nor are they the result of a series of observations directed to this particular point. And I may say further, that where, as in the Pennsylvania Hospital, recent accidents are taken into a receiving ward, the urgency of the work usually thrown upon the attendants is apt to prevent the taking of temperatures until the removal of the patients to the general wards, when it is at once instituted. Hence, some very low temperatures may have escaped notice. I should not feel that I had done justice to this matter if I made no reference to two important papers, one by Mr. Wagstaffe, and the other by Messrs. Churchill and Clark, which were published in the *St. Thomas' Hospital Reports* for 1870. Mr. Wagstaffe's article is especially on the temperature of shock in surgical cases. He mentions two fatal cases, one of burns and the other of a scald, in which the temperature in shock was 93.8° ; another of a burn, in which it was 96° . In one of concussion of the brain it was 93.5° ; the man recovered. In three fatal cases of fracture of the skull the temperatures were respectively 87.4° , 94.3° , and 95.2° . In one instance of compound fracture of both legs, with much hemorrhage, the temperature noted was 92.4° ; yet a double amputation was successfully performed. In a case of ovariectomy, which proved fatal from extravasation and peritonitis, the temperature just after the operation was only 90° . In a herniotomy, in which death ensued from the same cause, it was 94.4° ; and in a case of puncture of the liver it was 93° , death taking place in twenty-five hours. In a fracture of the fifth and sixth cervical vertebræ the temperature was 92.6° , the patient dying in thirty-two hours.

And here I would note what seems to me a very singular coincidence. Wagstaffe mentions the case of a man, aged forty-eight years, who fell a distance of forty feet, coming down upon his

head, and fracturing the sixth cervical vertebra. His temperature on admission to hospital was 92.3° , but before his death, which occurred in forty-eight hours, it fell to 81.75° . Churchill and Clark, in their paper, give the case of a man, aged twenty-two years, who fell forty-five feet, fracturing and dislocating the sixth and seventh cervical vertebræ; his temperature on admission to the hospital was 93.5° , and steadily declined until his death, about fifty hours afterward, when it was noted at 81.7° in the axilla. The similarity between these two cases is certainly very remarkable.

It would seem from the instances now given, that while the degree of lowering of the temperature affords a fair index of the severity of shock, it is not altogether reliable as a means of prognosis. Thus, in two cases in which it went down to 92.6° and 92.4° , recovery took place, although in the former the injury was a crush of both legs, requiring a double amputation. And it may be noted as a curious fact that very often, just before death, when the powers of life are on the point of extinction, the temperature rises five or six degrees above the normal. To this the case cited from Wagstaffe, and that from Churchill and Clark, are marked exceptions, the temperature in them going down to what I believe to be the lowest ever actually observed in living man.

I think most of the surgeons present will agree with me that the symptoms which cause them most apprehension in cases of shock are a leaky skin, dilated pupils, restlessness, especially if there is delirium, and very marked thirst. Each of these in itself may exist without special significance; but in combination they augur ill.

The influence of age, constitution, temperament, and race is very marked, not only in regard to the liability to shock, but as to the prominence of its several phenomena. Extreme youth and advanced age, in my experience, are alike apt to exhibit it in a pronounced degree. In children, I believe the symptoms belonging to the nervous system are of less moment than in older persons. In the very old there is often a state of apathy or torpor which is more unfavorable than excitement would be.

On the influence of constitution and temperament upon the occurrence of shock after injuries, I need hardly dwell, as it has not much practical importance. As to its bearing upon the pre-

vention of shock after surgical operations, this will come up more appropriately later.

The influence of race is very decided, and seems to be in somewhat exact proportion to the development and activity, or perhaps rather to the impressibility, of the brain and nervous system. We are told that the Hindoo races bear injuries and operations almost impassively. The negro seems but little susceptible to shock, and I think the same may be said of the Italian, and perhaps of the German, as compared with the Irishman. I have never had an opportunity to note the condition after recent injuries in Hungarians or in Chinese. The native American is rarely of unmixed blood, but the habits of life of most of our people are such as to stimulate them, and promote a general condition favorable to the occurrence of shock. Yet along with this there is often associated a buoyancy and determination which aids materially in reaction.

I have said nothing about the influence of sex, because I really know nothing about it. And I know of no observations upon which a comparison between men and women in this respect can be based.

As reaction takes place, the pulse becomes fuller, firmer, and slower, the respiration free and natural, the skin warm and dry, and the mind clear and steady. In a word, all the symptoms subside. Very often, perhaps invariably, there is for a longer or shorter period a precisely opposite condition, one of exaltation proportioned to the previous depression.

PREVENTION.—So far, what I have said has had special reference to shock as the result of injury. A very important branch of the subject, however, is that which concerns the bringing about of a like condition by the operations of surgery; and upon this, which might perhaps be better called the prevention of shock, I would like to offer a few words before taking up the matter of treatment.

In the times before the introduction of anæsthetics the endurance of an operation was in itself a cause of shock, just as an injury still is. This was partly prevented by benumbing the patient with laudanum or whiskey. At present, of course, pain is set aside almost invariably by ether or chloroform. But, as was most pertinently suggested by Dr. Cheever, of Boston, in a paper presented to the American Surgical Association in 1888, we have not only not done away with shock from surgical operations; perhaps in some ways we have made it more likely to occur. Rapidity of

operation, formerly of prime importance, is now regarded as needless, and patients are kept a long time in the state of narcosis. Free flushing of the wound, either with boiled water or with antiseptic solutions, is very generally and too often recklessly employed; the patient is apt to become drenched, and to be very seriously chilled in consequence. Being unconscious, he makes no complaint of exposure to cold, or of the discomfort of wet clothes or skin. I think any practical surgeon can attest the truth of these statements.

Here let me refer to a point which has frequently come under my notice. A patient who has met with an injury requiring operation is placed upon the table and anæsthetized; after a time he becomes pale, and manifests all the symptoms of profound shock; he vomits the contents of a full stomach, and the whole system is at once relieved. Of course, this can always be avoided when the operation is not one of emergency, which must be done at once without regard to the antecedent conditions.

When an operation can be foreseen and prepared for, the best safeguard against shock is the administration of a quarter of a grain of morphine hypodermatically half an hour or an hour before the time. Stimulants in moderation, and well diluted to promote absorption, may also be given; but I cannot wholly indorse Dr. Stephen Smith's proposition to give an ounce or two of whiskey in hot milk every two hours, for eight or ten hours, so as to produce a state of semi-intoxication. Our rule at the Pennsylvania Hospital is to give only liquid food on the day of operation, and but a small allowance of that. Here, I think, comes in the consideration of constitution and temperament. The feeble and timid need decided and vigorous stimulation physically and encouragement mentally. Stolid, calm, unimaginative persons are apt to have less shock, and hence require less in the way of precaution than the nervous, irritable, and sensitive. The patient should be well wrapped up, and during the entire time of the operation all needless exposure of surface sedulously avoided. By a proper arrangement of sterilized mackintosh the wetting of the clothing and of the skin, except at the part operated upon, can be prevented. No needless delay should occur, either in lecturing or demonstrating the steps of the procedure, or in procuring instruments overlooked beforehand. The administration of the anæsthetic in any but very brief operations should be intrusted only to an experienced person,

and should be carefully watched, only enough ether being given to maintain a sufficient degree of unconsciousness. The operation should be performed as quickly as possible with due regard to thoroughness of detail. Flushing of the wound should be done with hot water only—water hot enough to make the exposed tissues slightly gray or pearly in color, or at least as hot as one can well bear the hand in. As soon as the operation is concluded and the vessels secured, closure of the wound should be effected, and the dressings, prepared in advance, should be applied.

It may be well now to consider the question of operation in cases of shock. Suppose the case of a limb hopelessly crushed, what is the proper period for interference? It may be remembered that some of the British military and naval surgeons were wont to recommend "letting the knife follow the shot," with the idea that the pain of the amputation would act as a stimulus. But this was before the humanitarian period of surgery, and sprang, I think, partly from the then prevalent idea that there was something peculiar in the effects of gunshot wounds upon the human system. I think we must all of us have seen instances in which amputations were performed upon patients severely shocked from accidental injuries, yet with a successful result. But I also know that I have repeatedly seen such operations end badly, reaction seeming to be checked, and all the symptoms aggravated from the beginning of etherization. Many years ago I became satisfied that the effect of the inhalation of ether affords a tolerably fair test of the propriety of operation. A few whiffs of it may be given, the pulse being carefully watched; if this gains in force and volume, and becomes slower, the other symptoms will probably decline also, and the administration can be continued until the patient is ready for operation. If the pulse flags or becomes irregular, the ether should be at once withdrawn.

TREATMENT.—As to the treatment of shock, it will probably be conceded that the advance made in soundness of principle and efficiency of practice has been not the least among the improvements of modern surgery. The time was when the administration of alcoholic stimulants by the mouth was almost the sole reliance of the profession in dealing with this condition. By one surgeon of high standing, the late Dr. John T. Hodgen, they were utterly condemned; he regarded absolute rest as the essential and sufficient remedy. I am not aware that his views in this respect ever gained any acceptance.

That the patient should be disturbed as little as possible, all will admit; but few surgeons would be willing to trust to this alone.

In giving alcohol—and whiskey is the best form in which it can be used—what is needed is to get it into the circulation as soon as possible, and therefore it is a mistake not to dilute it freely with water, so that it may be absorbed readily. I think that in pronounced shock plain milk is apt to remain undigested in the stomach, and should therefore advise that, if given at all, it should be previously peptonized. Hot beef-tea, strong black coffee, carbonate of ammonia, and aromatic spirit of ammonia, all have value as stimulants to be taken by the mouth.

External heat should always be employed. As promotive of this, sinapisms have some advantage; applied to the epigastrium, they seem also to stimulate the plexuses of the ganglionic nervous system. The patient should be wrapped up, not merely covered over, with blankets (two are generally sufficient), and large bottles or cans of hot water placed about him. In hospital practice cylindrical rubber bags are provided for this purpose, and are encased in flannel bags for use. Sometimes heated flat-irons can be more conveniently had than the bottles of hot water. The heat should be applied between the body and the arms, and to the lower limbs. When ordinary untrained assistance only is at hand, the surgeon will do well to see that the patient is not overburdened with heavy coverings, heaped upon him with the idea that warmth can be thus obtained.

The warm bath advocated by the late Dr. C. T. Hunter, of Philadelphia, has undoubtedly been successfully used in some cases; but, as a general rule, dry heat will be found both more efficient and more conveniently applied. The lifting of the patient into the bath and out of it again involves a disturbance and a tax on the strength, which is better avoided.

A large enema of hot water (at about 105° F.) will sometimes be of great service as a stimulant, and if there has been much loss of blood, its absorption into the circulation will also do good. Peptonized beef-tea may be given in the same way.

As a direct stimulant to the brain strong aqua ammoniæ may be dropped on a napkin or sponge, and passed in front of the nostrils. The raising of the foot of the bed, so as to facilitate the supply of blood to the brain, is very useful; and by some surgeons the firm bandaging of the extremities has been resorted to with the same object.

When there is much pain from causes which cannot at once be removed, such as the pressure of the tourniquet, or severe nerve injury, recourse may be had to the hypodermic injection of morphine; one-eighth of a grain will generally suffice, and it may be repeated if necessary. The exhausting effect of severe pain is an immediate danger which it is most desirable to avert.

As a heart stimulant, tincture of digitalis may be used in like manner, 30 to 60 minims at a dose, and with this, if the skin is leaky, we may combine $\frac{1}{160}$ grain of atropine.

Hypodermic injections of alcohol or of ether are very often employed, with or without from $\frac{1}{100}$ to $\frac{1}{60}$ grain of strychnine. These articles, of course, are directed especially to the whipping up of a flagging nervous system, and through it of the heart and lungs.

When a large quantity of blood has been lost, and there is reason to believe that this is a potent factor along with the shock of the injury in inducing the condition of collapse, there would be reasonable ground for a resort to transfusion. I am not aware that this has ever been done with success in such a case; but theoretically it would be a proper course to pursue.

One of my former teachers used to be fond of speaking of the tripod of life—the brain, the heart, and the lungs. It seems to me that in our practical dealing with shock, our battle will always be best carried on if we bear in mind the importance of each of the elements of this combination; if in every case we are guided, not by a hard and fast rule or routine, but by the phenomena actually present before us. And I cannot close without referring to the fact, which might well be the subject of a special essay, that as surgeons we rarely have to treat the physiologically perfect or ideal man, in whom the tripod just mentioned is in every part solid and reliable. Those who come under our care are almost always the bearers of flaws of some kind, the scars of former battles against Nature. Overwork, dissipation, alcoholism, syphilis, tubercle, past disease, or perhaps merely the general hardships and exposures of a life of poverty and wretchedness, have in a very large proportion of our cases more or less impaired the strength of the organism, and sapped its powers of endurance. It is no doubt this unknown quantity in the equation that often baffles our best-directed efforts in behalf of the injured.