is a necessary sequence of the muscular contraction. If this elimination be prevented by interference with respiration, no amount of energy or volition on the part of the man will enable him to continue his exertion.

I have shown you how immensely superior the Prussian pack and accoutrements are to ours. Yet the authorities there are determined to profit by the experience of the late war; and a Commission is now reviewing the whole question, with a view to greater improvements; and, from what I have heard, unless we are early in the field with our improved system, I suspect the Prussian army will be soon accoutred on a plan as superior to the old as that was and is to the system still in force in the British army.

THE
Hastings Prize Essay,
1866.

ON
**SHOCK AFTER SURGICAL OPERATIONS
AND INJURIES.***

BY
FURNEAUX JORDAN, F.R.C.S.ENG.,
SURGEON TO AND PROFESSOR OF CLINICAL SURGERY AT THE
QUEEN'S HOSPITAL, BIRMINGHAM.

THE THERMOMETER IN SHOCK.

In order to give greater precision to, and, if possible, to extend our knowledge of, the phenomena of shock, I have in numerous cases, a few of which I shall cite, made use of the thermometer by the axillary method, the advantages of which have been so ably enforced by Wunderlich. It was long a tenet in physiology, that variations in temperature affect the surface only; and that the blood, as a whole, remains unaltered. The researches of Wunderlich, Parkes, Simon, and others, have shown that in inflammation, in febrile and other conditions, a considerable elevation of temperature above the normal heat of the blood is undoubtedly experienced. The same observers have also arrived at the conclusion, that diminution in the temperature of the body is rare, and much less extensive in its range.

In several cases in which I have used the thermometer after severe operations, such as amputation of the thigh, the temperature has descended to 97° Fahr., more commonly to 97° and a few tenths; its descent below 97° is rare. A few tenths of a degree only below 97° appears to be compatible with life. A most interesting and striking fact, which I have found to occur in all amputations of the thigh, is this: that when the saw is applied to the bone, the moment it comes into action, the temperature of the body suddenly falls a fifth of a degree, a little more or a little less. No change is seen when the soft parts are cut; and I have carefully investigated this

point by the use of the thermometer in many cases of amputation of the thigh—an operation in which the cut surfaces of the soft tissues are perhaps larger than in any other operation. That the thermometer should register a diminution in the temperature when the saw is dividing the bone, is most remarkable, because of its comparatively scanty supply of nerves; while the skin, so abundantly supplied with sentient or afferent nerves, gives rise, when cut with a knife, to no change in the temperature. The most probable explanation of this singular phenomenon is, the greater laceration of the nerves, smaller and fewer as they are, which instantaneously gives rise to shock, as indicated by depressed cardiac action and lowered temperature.

No change is seen in the thermometer on the administration of chloroform.

After the period of shock which immediately supervenes on a serious operation or injury, the temperature gradually rises, if the shock be not fatal, to a point above the normal standard corresponding to the degree of intensity of the fever of reaction. If the shock be fatal, the thermometer does not usually fall below 97° Fahr. The fever of reaction, so far as I have been able to observe, differs from “medical” fevers in the temperature which it reaches prior a fatal termination. While ordinary fevers reach a temperature varying from 106° to 110° just before death, the fever of shock, under similar circumstances, reaches a temperature only of 100° or 102°. Those cases of reaction are always the most dangerous in which the temperature keeps low, and especially at the early periods of fever.

I append a few cases in illustration of the several conclusions I have brought forward.

I shall give a tabular view of the cases, and comment upon them as I proceed. My observations, although mainly directed to the thermometric aspects of the cases, will extend to such other peculiarities as may seem to justify remark.

Tabular view of the case of Alice G., aged 22, showing the Temperature, and the condition of the Pulse and Respiration, just before, during, and at several periods shortly after, the operation of Resection of the Shoulder.

	Pulse.	Respiration.	Temp.
An hour prior to operation	92	18	98.8
Under chloroform	92	Irregular	98.8
Incision in soft parts	92	Irregular	98.8
Application of saw to bone	{ Suddenly slower }	Irregular	{ 98.8 98.6 }
When bone divided	92	Irregular	98.8
Fifteen minutes after operation	82	16	98.0
Six hours after operation	108	22	102.0
Morning, second day	106	28	100.0
Evening, second day	126	30	102.4
Morning, third day	120	28	102.0
Evening, third day	128	30	102.4

This case reveals a very slight form of shock, the temperature of the body at no time descending below 98° Fahrenheit. The sudden and momentary lowering of the temperature at the commencement of the sawing through the bone is very obvious. Reaction was rapid and sharp, and recovery favourable. The case was one of strumous osteitis affecting the head of the humerus, of three years' duration, numerous suppurating sinuses having been present for eighteen months.

* Continued from page 137 of JOURNAL for Feb. 9th.

Tabular view of the case of James S., aged 35, showing the Temperature, and the conditions of the Pulse and Respiration, shortly before, during, and shortly after, the operation of Amputation of the Thigh (Teale's method).

	Pulse.	Respiration.	Temp.
Shortly before amputation of thigh	120	28	99.2
During chloroform	120	Irregular	99.2
During incision in soft part	120	Irregular	99.2
On application of saw to bone { Suddenly slightly slower }		Irregular	{ 99.2 98.8
Operation completed	110	{ Irregular Slower }	{ 99.0
Thirty minutes after operation	105	30	96.4
One hour after operation ..	112	36	96.8
Eight hours after operation ..	140	40	97.0
Second day, morning	144	40	99.6
Second day, evening	156	38	102.0

This case shows a severe degree of shock, the thermometer descending to 96.4° Fahr.—a point which is rarely seen, as the temperature does not frequently sink below 97°. This and the other cases illustrate the disturbed relative frequency of the pulse and respiration which is very characteristic of shock. The cause no doubt lies in the direct influence which a violent impression on the nervous apparatus exercises on the respiratory function—an influence quite independent of the condition of the systemic and pulmonary circulations. The table shows the reaction, at first gradual, and then rapid, which is commonly seen in cases where the general health is moderately good, and the recovery favourable.

The next tabular view is one of the same case continued from the last into the early stages of reaction. It shows a tedious, irregular, and protracted febrile condition, which nevertheless slowly tends to the recovery which ultimately followed.

Another tabular view of the case of James S., showing the early stages of an irregular and protracted reaction. Ultimate Recovery.

	Pulse.	Resp.	Temp.
Morning, 11. (Thigh amputated at 10.30) ..	105	30	96.4
Evening	140	40	97.0
Second day, morning	144	40	99.6
Second day, evening	156	38	102.0
Third day, morning	148	37	101.0
Third day, evening	134	36	101.0
Fourth day, morning	132	34	101.0
Fourth day, evening	132	32	101.6
Fifth day, morning	136	30	100.6
Fifth day, evening	134	30	100.0
Sixth day, morning	132	28	99.0
Sixth day, evening	130	30	100.4
Seventh day, morning	128	36	100.0
Seventh day, evening	132	38	100.4
Eighth day, morning	135	37	100.8
Eighth day, evening	136	38	101.0
Ninth day, morning	134	36	100.4
Ninth day, evening	130	36	100.0
Tenth day, morning	120	—	99.0

The facts of the case, independently of those which appear in the table, are briefly these. Twelve months before his first admission into hospital, he had an injury to the left knee, the immediate result of which was synovitis. The synovitis was neglected at first, and afterwards resisted all treatment. Perfect rest in a favourable position was maintained for twelve weeks, with no apparent benefit. He then went into the country for several months, but

again entered the Queen's Hospital for amputation. The nervous temperament was not excitable, but the pulse was naturally weak. The stump healed quickly, and he went on to the "Green" before the end of the month. The fever following shock was variable and protracted; but at no time in its course did the thermometer show an unfavourable temperature. No fear was felt, therefore, as to the recovery, which followed in a few weeks.

Tabular view of the case of Eliza S., aged 52, showing the Temperature, and conditions of Pulse and Respiration, shortly before, during, and shortly after, the operation of Amputation of the Thigh (Teale's method) Death ultimately.

	Pulse.	Resp.	Temp.
Before chloroform	110	26	97
During chloroform	110	26 Irreg.	97
During incision	110	26 Irreg.	97
Saw applied to bone and moment after	{ Sudden slight fall }	26 Irreg.	{ 97 96.8
Bone divided	105	26 Irreg.	97
Fifteen minutes after operation ..	100	28	96.6
Sixty minutes after operation ..	108	28	97.8
Five hours after operation ..	96	25	97
Eight hours after operation ..	92	26	97.2
Eleven hours after operation ..	94	21	97.2

The case of Eliza S. is a striking contrast to the last, and shows well the different thermometric conditions in a case which is about to terminate unfavourably. The poor woman had been the subject of joint-disease (caries of the knee-joint) for several years. There were indications of the atheromatous diathesis, and suspicions of fatty change in the heart. The knee was removed by Teale's method. The resulting shock was not severe; but reaction was late, and never marked; and she sank on the tenth day. Her nervous system was weak, excitable, and unhelpful. The thermometric record is most instructive, and unusual in the low temperature which preceded and followed shock. Indeed, shock from psychical causes seems to have been present before the operation; and this probably was the cause of the less marked change after the operation.

I may remark here, parenthetically, that I have been struck with the fact that shock seems to be a protection against shock. In other words, when shock is induced, either from psychical or corporeal causes, a second operation of such causes during the shock has little effect in aggravating it. The ultimate result, however, is not the less but the more unfavourable, as it is supposed to be seen in "primary" operations.

Appended is a tabular view of the observations during reaction, in the same case, to its unfavourable termination. I regret that, in this case, only single

Tabular View of the case of Eliza S., showing the Temperature, Pulse, and Respiration, during reaction, to the fatal result.

	Pulse.	Resp.	Temp.
First day	96	25	97.0
Second day	120	26	98.4
Third day	116	24	99.0
Fourth day	120	22	98.8
Fifth day	128	24	101.0
Sixth day	124	22	100.4
Seventh day	120	25	101.0
Eighth day	126	24	101.4
Ninth day	124	22	101.0
Tenth day (death)	124	22	98.4

thermometric observations were taken each day. The morning and evening variations, however, are less marked and more uncertain in the fever of reaction.

Tabular view of the case of Aaron B., aged 4, showing the Temperature, Pulse, and Respiration, shortly before, shortly after, and also during the early periods of Reaction which followed, the operation of Lithotomy (lateral method). Recovery.

	Pulse.	Resp.	Temp.
Before operation	100	20	98.8
Fifteen minutes after operation			98.4
Six hours after operation	130	26	99.8
Second day, morning	120	20	100.0
Second day, evening	140	20	103.0
Third day, morning	136	22	100.2
Third day, evening	130	22	102.2
Fourth day, morning	116	20	99.8
Fourth day, evening	100	20	100.8
Fifth day, morning	96	20	99.4

This case shows the effects of the operation of lithotomy in a moderately healthy boy of four. The temperature does not get below 98°. Reaction is seen to be quick and high, with also quick subsidence. The morning and evening variations are more regular.

Tabular view of the case of Joseph W., showing the Temperature shortly before, during, shortly after, and at other periods after, Amputation of the Thigh (Teale's method). Recovery.

	Temp.
Before chloroform	98.4
Under chloroform during incision	98.4
Saw applied, and moment after	98.4
Fifteen minutes after operation	97.0
Sixty minutes after	97.8
Six hours after	98.5
Second morning	99.2
Second evening	99.4

Tabular view of the case of Joseph W., showing the Temperature, Pulse, and Respiration, during reaction.

	Pulse.	Resp.	Temp.
First morning	110	..	97.8
First evening	126	26	98.4
Second morning	126	24	99.2
Second evening	..	..	99.4
Third morning	128	24	98.6
Fourth morning	126	22	99.0
Fifth morning	130	24	100.0
Sixth morning	128	22	99.0
Seventh morning	130	22	99.0
Eighth morning	128	22	99.0
Ninth morning	124	22	98.8
Tenth morning	120	22	98.4
Eleventh morning	124	24	98.6
Twelfth morning	120	22	98.6
Thirteenth morning	120	22	98.6

The two tables of the case of Joseph W. are interesting as showing the effects of shock on a boy of ten, who was in a state of extreme weakness at the time of operation, from the effects of acute peritonitis of shaft of femur three months before, and from which he narrowly escaped with his life. The first table, marked in tenths of a degree, shows the sudden fall of the temperature one-tenth of a degree when the saw commenced to divide the bone. The phenomena of shock were very marked. The thermometer rapidly went down to 97° Fahrenheit, but not lower. Reaction was quick, but not very high.

Recovery followed. This case was under the care of my colleague Mr. Wilders.

Tabular view of the temperature in the case of G. C., aged 63, the evening before, two hours after, and at repeated intervals after, amputation below the knee.

	Pulse.	Resp.	Temp.
Evening before operation	84	17	99
Two hours after operation	97	18	98.6
Day of operation, evening	88	17	98.0
Second morning	120	29	103.6
Second evening	120	28	103.6
Third morning	112	28	101.9
Third evening	148	33	98.6
Fourth morning	100	19	100.6
Fourth evening	108	28	102.2
Fifth morning	88	28	102.0
Fifth evening	90	28	101.0
Sixth morning	88	19	99.5
Sixth evening	92	23	109
Seventh morning	86	22	99.4
Seventh evening	92	23	100.6
Eighth morning	80	21	98.9
Eighth evening	84	21	100
Ninth morning	84	22	99.2
Ninth evening	90	28	101
Tenth morning	78	22	98.3
Tenth evening	88	25	100.4
Eleventh morning	82	21	99
Eleventh evening	88	23	101
Twelfth morning	88	22	100.9
Twelfth evening	95	24	100
Thirteenth morning	84	23	99.2
Thirteenth evening	88	26	100
Fourteenth morning	78	24	99
Fourteenth evening	90	26	100.4
Fifteenth morning	89	24	99
Fifteenth evening	90	30	98.8

The foregoing table presents the thermometric changes following amputation below the knee for senile gangrene. G. C., aged 63, had led an irregular life. At forty years of age, the left femur was broken twice. The left lower extremity had frequently sustained injury; on one occasion, the bones of the foot were broken. He was admitted into the Queen's Hospital with a slough behind the ankle, invading the tendo Achillis. Three months later, gangrene appeared in the little toe, and in a couple of weeks involved the two adjacent toes and a portion of the foot. Four months after admission, amputation was performed below the knee. Reaction was somewhat delayed, but was well marked, as the table shows. On the third and fourth days, a considerable portion of the flaps sloughed: with this change, the temperature rose again, after its subsidence from reaction. After this, no further sloughing occurred; the stump cleaned; and the case went on favourably on the whole, except that opium was not admissible, in consequence of the prolonged semi-coma which it produced. On the fourteenth day, a bed-sore was detected. [At this point, it was necessary to complete and deliver this essay.]

REMARKS. This is not the place to consider the treatment, old or new, of senile gangrene. The case is given as an example of shock after amputation of the leg in an old man, the subject of marked atheroma. But, in adopting an unusual mode of treatment, I may be permitted to state briefly my reasons. In my experience, and within my opportunities of observation, the let-alone treatment of senile gangrene has always been fatal; it is only rarely otherwise. Mr. James of Exeter and others have, with success, amputated high in the thigh in these cases. It occurred to me that amputation just above (which I believe is best), or just

below the knee, would be less serious in itself, and would also be in parts possessed of active circulation. A curious case confirmed me in this view. In a case of senile gangrene, amputation below the knee was performed by a surgeon who did not consider the gangrene to be of senile character. Several years of active life followed, when senile gangrene occurred in the other foot. Another and an able surgeon adopted the usual treatment; and the patient very slowly sank, became comatose, and died.

Tabular view of the Temperature the evening before, shortly before, shortly after, and at repeated intervals after, Removal of the Breast. Case, Bridget F., aged 47. Scirrhus Cancer of Breast.

	Pulse.	Resp.	Temp.
Evening before operation	82	—	98.5
Shortly before operation	—	—	98.0
Three hours after operation	80	—	97.5
Six hours after operation	88	31	97.6
Second morning	104	25	99.0
Second evening	92	29	98.8
Third morning	105	32	98.6
Third evening	108	24	100.4
Fourth morning	108	30	100.4
Fourth evening	110	28	100.0
Fifth morning	95	24	99.2
Fifth evening	100	30	98.4
Sixth morning	98	23	98.0
Sixth evening	98	21	98.9
Seventh morning	96	21	100.5
Seventh evening	112	32	102.0
Eighth morning	104	21	99.6
Eighth evening	108	22	100.5
Ninth morning	96	22	98.2
Ninth evening	103	23	100.6
Tenth morning	84	17	98.2
Tenth evening	84	22	99.0
Eleventh morning	82	19	98.0
Eleventh evening	92	19	98.0
Twelfth morning	92	18	98.2
Twelfth evening	90	19	98.0
Thirteenth morning	95	18	98.2
Thirteenth evening	104	23	98.8
Fourteenth morning	88	24	98.5

The case of Bridget F. shows slight mental shock just before operation. The next thermometric observation was too late to get the full reduction in temperature. The reaction was somewhat irregular, owing, apparently, to the highly emotional temperature of the patient—an Irishwoman. More than once she said she was going to die. We could detect no ground for such fears but elevation of temperature; in short, increased fever followed. The case recovered.

Tabular view of the case of William F., aged 14, suffering from internal injury, probably Contusion of the Liver.

	Pulse.	Resp.	Temp.
Noon, two hours after injury	112	41	97
First evening	124	33	100.5
Second morning	136	33	102.0
Second evening	132	33	102.6
Third morning	128	36	100.6
Third evening	128	40	102.6
Fourth morning	104	29	100.2
Fourth evening	106	32	101.4
Fifth morning	96	27	100.2
Fifth evening	100	24	100.4
Sixth morning	98	26	100.0
Sixth evening	104	33	101.0
Seventh morning	96	28	100.0
Seventh evening	100	32	101.9
Eighth morning	88	26	99.6
Eighth evening	90	31	100.4
Ninth morning	88	26	99.6
Ninth evening	92	31	100.2

William F., aged 14, was knocked down by a heavy weight, and was brought into hospital with marked collapse. The locality of the pain and tenderness and other symptoms appeared to point to injury to the liver. The table shows marked and very slowly subsiding reaction. The case was left progressing.

The cases which I have brought forward, and others which I have carefully examined, suggest the following conclusions as regards the use of the thermometer in shock.

1. The temperature in the fever of reaction should rise shortly after the injury or operation, and should reach a point between 101° and 103° not later than the morning of the second day.

2. When the temperature remains for some days below 100° or 101°, after a severe injury or operation, an unfavourable result may be anticipated.

3. When the temperature, especially after being low for some time, rises above 103° to 105° or 106°, a fatal termination is close at hand. But more commonly, in death after injury, the temperature fails to reach to these degrees.

4. The temperature is not altered by the administration of chloroform.

5. The temperature is not affected by incisions in the soft parts, however extensive. This conclusion is based on cases in which the incisions were made when the patient was under the influence of chloroform.

6. The temperature instantaneously falls when the long bones are divided with the saw. The diminution of temperature is from one to four tenths of a degree (Fahrenheit).

7. The temperature falls, in severe shock in the adult, to 97° or 97° and a few tenths. In the young, it does not fall as low as in the adult; it falls lowest in the aged.

8. It is rare, under any circumstances or at any age, at the moment of most intense shock, or at the moment of death from shock, for the temperature to descend below 97°, and probably never below 96°.

9. In the fever of reaction, especially in its early stages, the morning and evening variations are less regular than in "medical fevers". In the later stages, however, the absence of morning subsidence, and even of evening increase, are of unfavourable import.

10. The correspondence between the temperature and the pulse, and especially between the pulse and the respiration, is less in the fever of shock than in "medical fevers".

11. The thermometer furnishes the most reliable information (more than the state of the pulse and respiration) of the real nature of shock and reaction, and its data afford the safest grounds for prognosis.

[To be continued.]

THE REACTIONS OF MORPHINE AND NARCOTINE. M. Husemann's process for distinguishing morphine consists in dissolving the matters to be tested in concentrated sulphuric acid, and adding a drop of nitric acid to the solution. If morphine is present, it immediately produces a coloration varying from rose to the most intense carmine, and by heating for some minutes to 100° or 150°, a magnificent violet colour appears, which afterwards changes to blood-red. Narcotine becomes bluish-green in cold sulphuric acid, turning violet-red by the action of heat. (*Journal de Pharmacologie*.)